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VOL. CLXXXVI. No. 3440.] WEDNESDAY, APRIL 24, 1929 [81ST YEAR.

Editorial Notes.

Institution of Gas Engineers.

THE Annual Meeting of the Institution of Gas Engineers will be held in London this year, at the Institution of Civil Engineers, Great George Street, Westminster. On the first day, Tuesday, June 4, Mr. John Terrace, M.Inst.C.E., Chief Engineer of the South Suburban Gas Company, will deliver his Presidential Address, which will be followed by the reading of papers and the presentation and discussion of Reports of Committees, on Tuesday afternoon, Wednesday, June 5, and Thursday, June 6. The President's Reception and Dance will be held in the King's Hall, at the Holborn Restaurant, on the Tuesday.

A visit will be made to the South Suburban Gas Company's Works on Thursday afternoon, and there will be an excursion up the River Thames to historic Hampton Court on Friday, June 7. On the evening of that day (Friday) a party consisting of members of the Institution and of the British Commercial Gas Association, with their ladies, will leave for Berlin to visit the German Gas and Water Exhibition and to attend the meeting of the German Association of Gas and Water Engineers. They will arrive in Berlin on Saturday, June 8, and leave on the following Thursday, getting back to London in the morning of Friday, June 14. Alternative arrangements are being organized. In the first, the visit is extended by spending a full day in Hamburg and returning by a Hamburg-America liner on Friday, arriving in Southampton late on Saturday night, June 15. The second alternative provides for a visit to Frankfort, Wiesbaden, and Cologne. The Committee in charge of the arrangements have also prepared, with Messrs. Thos. Cook, who are making the necessary provision for hotel accommodation and travel, for the possibility of any visitor making a longer stay in Germany.

Second Reading of the Gas Bill.

FROM the report appearing in our "Parliamentary Intelligence" to-day, readers will note with satisfaction the fact that the Gas Undertakings Bill, which has already passed through the House of Lords, was, last Friday, without a division, read a second time in the House of Commons, and was referred to a Committee of the Whole House. The second reading was moved by Mr. H. G. Williams (Parliamentary Secretary to the Board of Trade), who pointed out the impossibility of carrying a controversial Bill in the remaining life of the present Parliament; but, while feeling grateful for the relief which this measure affords it, the gas industry will still press on for a further measure of legislative reform as soon as circumstances permit.

Mr. Williams pointed out that between 1920 and 1927 the gas industry's sales rose from 235,000,000,000 c.ft. to 280,000,000,000—an increase of practically 19 p.ct. Under more favourable conditions, of course, this rate of progress might perhaps have been greater; but if it is to be even maintained in the future, it is essential that the gas industry should have the fullest possible freedom in meeting the changed conditions of the present time.

Initial Care of Retort Settings.

EVERY junior in the gas profession will benefit by careful study of the lucid and practical paper which Mr. F. J. Bengough, Carbonizing Superintendent at the Nechells Gas-Works, contributed to the proceedings of the Midland Junior Gas Association last Thursday. During the past few years there have been several valuable papers dealing with the general control of carbonizing plants when these are in actual operation; and no one to-day is lacking in appreciation of the fact that strict technical supervision of retort settings is brightly reflected on the credit side of the works balance-sheet. On the other hand, comparatively little has been published concerning the methods of ensuring lasting economies by close attention during the initial stages of heating-up. Mr. Bengough's precise treatment of this period of anxiety is thus more than welcome, for it is impossible to over-estimate the beneficial results which follow the exercise of care and patience in bringing a setting into working condition.

Customarily, gas engineers make the contractors of carbonizing units responsible for their lighting-up. It can be said at once that our industry is extraordinarily well served by the manufacturers of gas-works plant, and that the technical efficiency of the staffs of British gas engineering firms leaves nothing to be desired. The period which must elapse before a completed setting can commence gas-making is, however, lengthy; and the expenses of the contractors' carbonizing staffs cannot be light. Business being business, and competition not being wanting, there can be no strong wish unduly to prolong this period on the part of engineering firms; there may be a pardonable and wholly natural tendency to shorten the time between the laying of the foundations and the typing of the guarantee results. Consequently there is much point in Mr. Bengough's suggestion that settings should be dried-out, lighted-up, and worked during the guarantee period by the gas engineer to his own satisfaction, under the supervision of the contractors' carbonizing staff. If trouble is experienced during or after this time, the responsibility will rest largely with the contractors; but the engineer will have the satisfaction of knowing exactly what has taken place to cause it.

Mr. Bengough speaks simply and concisely; his paper being based on long experience, not on text-books. He explains how necessary it is that the gas engineer should be a super-policeman, and not allow assumptions to influence his sense of satisfaction. In brief, it is safe to take nothing for granted. Deliveries of the "same" re-

fractory materials have been known to differ in shape, size, or quality; bricklayers supplied with correct jointing material have been known to yield to the alluring temptation of adding a pinch of Portland cement; expansion cavities of the erected setting, it has been discovered, do not always tally with the dimensions so meticulously set-out on the detailed drawings; strange obstructions have been found in flues; and so on. But the application of Mr. Bengough's suggestions will provide a remedy for such accidents; and after the day when the setting is actually lighted-up, the engineer will be able to enjoy peace of mind in his home circle.

Going Hand in Hand.

Of recent years there has been a good deal of advocacy in this country of the policy of combining in one undertaking the supply of both gas and electricity; and from the point of view of economy there obviously must be much to recommend such a course. There are some excellent instances to be found in operation, but the idea has not been adopted to the same extent here as in the United States; and even in the case of municipalities where the supply of the two commodities is in the hands of a single Committee, suggestions have been noted that in the interests of one of the commodities competing departments would be preferable. This is not how the matter is regarded on the other side of the Atlantic. There it is found that electricity can go forward, hand in hand, from prosperity to still greater prosperity—with naturally lee-way being made up by the younger sister.

A striking example of the success of this policy is provided by the Consolidated Gas, Electric Light, and Power Company of Baltimore, whose year book for 1928 (compiled by Mr. Arthur W. Hawks, jun.) contains some remarkable statistics, showing that in that year the people of Baltimore and adjacent counties used more electricity and more gas than during any other year in the history of the Company. Since 1910 (when Baltimore received its first hydro-electric power from the Susquehanna River) the Company have reduced the average rate for electricity 49 p.ct., and the average rate for gas 16 p.ct. What this culmination of many rate reductions means to the consumers will be seen from the calculation that had the electricity and gas which the Company sold in 1928 been billed at the rates charged in 1910, the public would have paid $17,252,643 more than they actually did. Furthermore, during this eighteen-year period the Company have paid in the form of taxes $24,750,203.

Still examining the same period, it is found that the Company serve twelve times as many electricity consumers as in 1910; while the number of gas consumers has been about doubled. The distribution system for the former now covers sixteen times as many square miles as eighteen years ago; and the gas mains traverse nearly twice as many miles. The gas service pipes have increased from 99,460 to 179,000. The sales of electricity are seventeen times as great as in 1910, and the sales of gas nearly four times as great. The *per capita* use of electricity is twelve times as great; while that of gas has grown from 4629 c.ft. to 13,487 c.ft. per annum. The average number of employees per 1000 customers, gas and electric, has been reduced from fourteen to ten; and this in spite of the fact that the locations at which service is rendered cover a much larger area. In 1910 seven employees were stockholders; last year 1212 of them were stockholders, or were acquiring stock on advantageous terms. To sum up, more than one-half of the total population of Maryland lives within the territory to which the Consolidated Company of Baltimore has brought the conveniences of the city in the form of its public service of gas and electricity. Within the territory covered by the steam heating system—a territory which is to be extended as rapidly as possible—it is now possible for Baltimore business establishments to receive heat, power, and light for all requirements by simply connecting-up with the Company's distribution system.

Here is an instance of gas and electricity in close co-operation, to their mutual benefit, which should go far to reassure those who feel that in such a partnership one or other might be unduly handicapped.

Suicide and Accident Statistics.

In connection with the proposal of the President of the Board of Trade to appoint a Committee to consider the question of gas poisoning, figures have been quoted for 1927, when the number of suicides by gas was 943, and the other deaths from gas poisoning (including doubtful cases, which may have been either accidental or deliberate) numbered not more than 150. This proportion of more than six suicides to one accident is rather astonishing, and has led some people to express themselves as though no other method of taking one's life was at hand. This is, of course, far from being the case. Suicides by gas, numerous as they have been, were in 1927 only about one-fifth of the total number of suicides from all causes in 1928. During the twelve months ended Dec. 31 last, the numbers of persons found by coroners' verdicts to have committed suicide were 3381 males and 1464 females.

Keeping in mind the number of fatal gas poisoning cases recorded in 1927—namely, 150—let us glance for a moment at figures quoted by the Home Secretary (Sir William Joynson-Hicks), when speaking as President of the National "Safety First" Association. He referred to the two big classes, industrial accidents and road accidents, and said it was a remarkable thing that the public should take very much more interest in the road accidents. This is not surprising, in view of the steady increase in the number of road accidents during the last few years. In 1927 there were 2567 fatal industrial accidents; while in 1928 the number of pedestrians killed was 3255, of motor-cyclists 1395, and of pedal-cyclists 691.

With these figures in mind, one is inclined to agree with the Home Secretary in his remark that "it would almost appear that the most dangerous occupation in life is that of a pedestrian." It is certainly immeasurably more dangerous than being brought into contact with the public gas supply, which as we have already shown was responsible for 150 accidental deaths in 1927.

Blazing the Trail.

To our readers Mr. S. M. Milbourne is no stranger. His precise and accurate treatment of a difficult subject—the mechanics of gas storage plant—has, we know, been appreciated, and his contributions which have been published from time to time in the "Journal" serve as sources of reference. A notable addition to the list is made in our issue to-day, which contains the first part of a mathematical interpretation of the problems of storing gas under pressure—a new and fascinating phase of gas engineering as far as this country is concerned.

The author cites the advantages and disadvantages of spherical holders. Among the former may be counted the small ground space necessary for erection, uniform stresses, suitability for soft yielding ground, pleasing appearance, dry gas, and high capacity-size ratio. The last-named advantage is strikingly illustrated in a diagrammatic comparison of the "Hortonsphere" with other forms of holder having the same capacity at 5 to 8 in. water gauge. There is another point in favour of pressure spheres—low cost of painting. In this connection the author mentions that the most suitable colours to adopt are those which reflect the rays of the sun as much as possible, and experience has shown that aluminium or white paint is the best. A good reflecting surface is particularly important during spring and autumn, when the range of temperature experienced in this country during twenty-four hours is in the neighbourhood of 25° C. (45° Fahr.). Our old friend M. Charles is called upon to indicate what influence this variation in temperature has upon the pressure in a spherical holder.

There are three disadvantages of storing gas under pressure: Dependence upon the compressing unit, its running costs, and the attention it requires. Mr. Milbourne shows how the application of theoretical principles can reduce those disadvantages to a minimum; and he emphasizes that, to achieve this end, the principles must be applied to carefully-investigated local circumstances. For the present, the adoption of the pressure sphere will, we think, be generally confined to district storage in outlying

areas; the method being to draw the gas from a low-pressure main during the "off-peak" period by means of an automatically operated compressing unit. The chief problem is the decision as to the size of compressor to instal; and in this regard the mass of data given by the author will be extremely useful.

Before we terminate this brief pointer to Mr. Milbourne's welcome contribution, attention may be called to his statement that, while ordinary coal gas and water gas mixtures may be stored under pressures of 50 to 60 lbs. per sq. in., without any appreciable detriment in quality or loss in volume, with oil gas the position is somewhat different, for there are a number of hydrocarbons present near the point of saturation at low pressures. Consequently, further experiments are necessary before any definite conclusions can be arrived at respecting the advisability of storing oil gas mixtures under high pressure.

Becker Coke Ovens at Bedwas.

It is understood that the Bedwas coke oven and bye-product plant of British Benzol and Coal Distillation, Ltd., reference to the commencement of which was made in the "Journal" for Feb. 6, p. 366, is now nearing completion, and in a few months will be producing about one-and-a-half million gallons of motor spirit and other oils per annum. The new carbonization plant embodies a high-temperature process, and is designed to use nearly 700 tons of coal per day. The plant will turn out about 140,000 tons of foundry coke and 42,000 tons of domestic coke a year, and, as stated previously, will consist of 35 Becker high-temperature coke ovens, each having a daily carbonizing capacity of approximately 18 tons. The ovens are heated by a portion of the gas driven off from the coal. The coal slack from the Bedwas Navigation Colliery is conveyed on belt conveyors to a Peale-Davis dry cleaning plant, whence it is carried by aerial ropeways to the oven storage bins. In the bye-product plant are produced sulphate of ammonia, tar, and motor spirit. In order to obtain the maximum value from the tar, it is distilled into various fractions, such as light oils, solvents, creosote, and pitch. The Bedwas Colliery, which employs 2500 men, is one of the largest in the South Wales coalfield. It is an interesting fact that in the United States alone over three thousand Becker ovens of a similar type to those at Bedwas have been erected with a carbonizing capacity of 24 million tons of coal a year, or over 50 p.ct. greater than the present output of all the coke ovens in Great Britain.

The Distribution Side.

Some idea of the amount of new domestic supply business with which gas undertakings have been faced is furnished by the statement that the total number of houses built in England and Wales up to the end of March since the Armistice is put at 1,271,848. The Parliamentary Correspondent of "The Times" says that there has naturally been some slackening-off in the effort to overtake arrears since the million mark was passed; but it is known that no fewer than 166,792 houses were built in the last financial year, of which 104,792 were built with the help of the subsidy.

Low-Temperature Carbonization Patents.

In a paper before the Second International Conference on Bituminous Coal, Mr. W. A. Darrah stated that many of the processes of low-temperature carbonization now being exploited differ in detail from early disclosures; and as a result there are hundreds of issued patents, and undoubtedly many more pending patent applications, covering various phases of the industry. At the present time, he suggested, it is difficult to say what system, if any, is clear of infringement of other patents, or what process may be completely controlled by patents in the hands of its exponents. It should be emphasized that, before embarking on extensive investments, this phase of the matter should be thoroughly investigated from the viewpoint of both offence and defence.

General Strike Affects Trades Union Membership.

It was known, of course, that the general strike of 1926 had had a highly detrimental effect upon the membership and the funds of the trades unions. Indeed, such a result was only to be expected. The report on trades unions for the year 1927 of the Chief Registrar of Friendly Societies shows how disastrous from these points of view the effect has been. The loss of membership amounted to no less than 300,000, nearly one-half of which occurred in the mining group; while as a result of the abnormal expenditure which the troublous times involved, the funds of the trades unions were reduced by £4,100,000 to £8,478,000. The decrease in membership of the whole mining and quarrying group of unions was 140,000.

Nitrogen Fixation in Russia.

Plans for the construction in the Soviet Union of a £2,000,000 factory to produce synthetic ammonia fertilizers are being prepared by the Nitrogen Engineering Company of New York. A contract with the Company has been concluded for a term of ten years.

"Gas Salesman" Supplement.

The "Gas Salesman" Supplement which is included with this issue of the "Journal" is the first of the monthly numbers for the present season. It contains a well-reasoned address by Mr. Ernest Hunt, whose lecture before the "B.C.G.A." at their York Conference was so greatly enjoyed. There are also a number of meetings of Circles, whose session is now drawing to a close. The topical subject of refrigeration by gas is discussed by the Southern District (London Area).

FORTHCOMING ENGAGEMENTS.

[Secretaries of Gas and Kindred Organizations are asked to assist in making this diary of events as complete and useful as possible by sending the earliest intimation of all meetings.]

April 30.—Society of British Gas Industries.—Annual General Meeting at the Hotel Metropole, Northumberland Avenue, W.C.

May 1 and 2.—Eastern Counties Gas Managers' Association.—Spring Meeting at the Hotel Cecil, London.

May 2.—British Commercial Gas Association.—Scottish District Conference at Aberdeen.

May 2-3.—Iron and Steel Institute.—Annual Meeting at the Institution of Civil Engineers.

May 3.—London and Southern District Junior Gas Association.—Annual General Business Meeting at the Westminster Technical Institute.

May 4.—Midland Junior Gas Association.—Visit to the Leamington Gas-Works.

May 4.—Manchester and District Junior Gas Association.—Visit to the Blackpool Corporation Gas Department. Paper by T. Reynolds on "Works Extensions."

May 4.—Scottish Junior Gas Association (Eastern District).—Annual General Meeting in Edinburgh.

May 8.—British Commercial Gas Association.—Annual Meeting of the Eastern District at Peterborough at 3.30 p.m.

May 10.—British Commercial Gas Association.—Manchester District Conference at Southport.

May 10.—Southern Association of Gas Engineers and Managers.—Visit to Exmouth.

May 11.—Yorkshire Junior Gas Association.—Meeting at Leeds. Short papers by Messrs. H. E. Wilde (Bradford), S. T. S. Musgrove (Sheffield), and F. J. Jackson (Sheffield).

May 16.—Midland Association of Gas Engineers.—Visit to Shrewsbury.

May 16.—Midland Junior Gas Association.—Annual General Meeting in Birmingham.

May 16.—Wales and Monmouthshire District Institution of Gas Engineers and Managers.—Meeting at Cardiff.

May 24.—North of England Gas Managers' Association.—Annual Meeting.

June 19.—Association of Statutory Inspectors of Gas Meters.—Annual General Meeting in the County Hall, Westminster: President, Mr. H. N. Barrow, J.P.

July 5.—Manchester District Institution of Gas Engineers.—Visit to the Halifax Gas-Works and to the Works of Messrs. Drakes, Ltd.

Sept. 12.—North British Association of Gas Managers.—Annual Meeting at St. Andrews.

PERSONAL.

Councillor A. F. Bullen has been elected Chairman of the Gas and Water Committee of the Wallasey Corporation.

At the conclusion of their meeting on March 1, the Directors of the Gas Light and Coke Company said farewell to Mr. A. C. McMinn, the Engineer-in-Charge of the Shoreditch Works, on his retirement after nearly forty-five years' service. In presenting Mr. McMinn with a silver Jacobean coffee set and tray, on behalf of the Court of Directors, as a mark of their appreciation of his long and faithful service, Sir David Milne-Watson, the Governor, said that from the time Mr. McMinn first entered the Company's service in 1884, he had always had the Company's interests at heart and, by his unfailing thought for others, had won the respect and esteem of all those about him. Mr. McMinn's record was all the more remarkable in that his family had been connected with the Company since 1843, Mr. McMinn's grandfather, father, uncle, and brother all having served the Company for a considerable number of years—the service of the five members of the family totalling no less than 190 years. Mr. McMinn expressed his thanks to the Governor and Directors for their gift. The high regard in which Mr. McMinn was held by his colleagues was testified by a gathering of the Station Engineers of the Company which took place at the Hotel Cecil, when Mr. Thomas Hardie, the Chief Engineer, presented him with a gold English lever hunter watch and a cigarette case, as a memento from his colleagues on the Engineers' Committee.

The importance of chemistry in the gas industry was emphasized on April 3 at a testimonial dinner to Mr. Edward C. Uhlig, Chief Chemist of the Brooklyn Union Gas Company. The dinner, held at the Elks Club, Brooklyn, N.Y., was given in recognition of his twenty-five years' continuous service with the Company. Mr. Clifford E. Paige, Vice-President and Chief Engineer of the Brooklyn Union Gas Company, stressed the importance of chemistry in the gas business, and told of the valuable services rendered by Mr. Uhlig in his quarter-of-a-century of service, not alone to the Company, but to the gas industry as a whole. Other prominent speakers, all complimenting Mr. Uhlig on his record of service, were Major Alexander Forward, Managing Director of the American Gas Association; Mr. F. C. Weber, Assistant Vice-President of the Brooklyn Union Gas Company, and Mr. W. Cullen Morris, Vice-President and Chief Engineer of the Consolidated Gas Company of New York. During the evening he was presented with a handsomely fitted travelling bag.

It was announced in the "Journal" for April 3 that Mr. Walter T. Dunn, formerly Secretary of the Institution of Gas Engineers, had been adopted as the prospective Liberal candidate for Hastings. Acting on medical advice, however, he has decided to withdraw from this position.

On the occasion of the golden wedding of Mr. J. W. Slack (Vice-Chairman and Managing Director of Richmond's Gas Stove Company, Ltd.) and Mrs. Slack, a presentation was made at the Warrington Works of the Company on Wednesday, the 17th inst. This took the form of a silver gilt tea tray, and was contributed to by the Warrington and London staffs, the representatives, and the workpeople of the Richmond Company. Mr. H. M. Thornton, J.P. (Chairman of the Company), made the presentation on behalf of the subscribers. There was a very large and representative gathering assembled to express regard for Mr. and Mrs. Slack.

OBITUARY.

ALEXANDER WILSON.

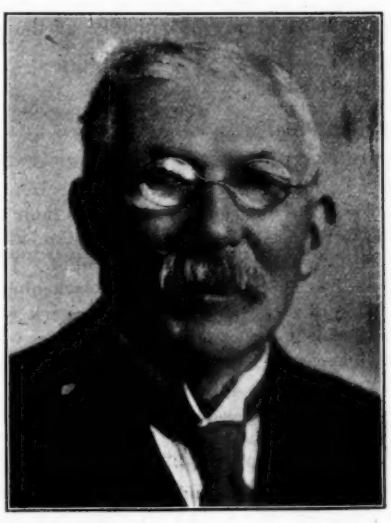
We are very sorry indeed to have to record the death, which took place suddenly on April 15, at Baronald, Leven, of Mr. Alexander Wilson, late Chief Engineer and General Manager of the Glasgow Corporation Gas Department. Deceased, who was 74 years of age, was born in Leven, and was apprenticed as an engineer in the workshops and drawing office at the Durie Foundry of Messrs. Henry Balfour & Co., by whom he was sent to Bolivia to supervise the erection of works for the manufacture of nitrate of soda.

On his return, after completing several contracts in connection with gas-works for the firm, he entered the service of the old Phœnix Gas Company (later amalgamated with the South Metropolitan Gas Company) in order to gain a practical knowledge of gas manufacture on a large scale. After a preliminary training in their Vauxhall Works, he was placed in charge of the carbonizing department. During this time, he designed and carried out several improvements in retort settings. Having subsequently been selected as an assistant by Mr. Robert Morton, then Engineer to the London Gas Company, he was put in full charge of the construction department at their Nine Elms Works. On the amalgamation of the Company with the Gas Light and Coke Company, and the retirement of Mr. Morton, he was appointed Deputy Engineer under Mr. John Methven, with whom he was associated in designing and carrying out a thorough reconstruction of the works, whereby their productive capacity was increased to 12 million c.ft. per day. He also extended the system of regenerative firing to the stage retort-houses.

Thirty Years in Glasgow.

After ten years' service at Nine Elms, Mr. Wilson obtained the appointment of Manager of the Dawsholm and Temple Gas-Works of the Glasgow Corporation; and here he had the practical supervision of the many important alterations and extensions which were carried out at these works. The manufacturing capacity of the stations when he took charge of them was about 6 million c.ft. per day; whereas by 1903, when he was promoted to the position of Chief Engineer and General Manager of the Glasgow Corporation Gas Department it amounted to 20 millions. While at Dawsholm, the experience he had gained in London, under engineers who were considered the most progressive and in the front ranks of the profession, coupled with his engineering training, enabled Mr. Wilson to materially assist Mr. William Foulis (then Chief Engineer) in working out many improvements in gas manufacture. A proof of Mr. Foulis's high opinion of him was afforded by the fact that the new works at Provan were erected mainly on the lines of the latest works at Dawsholm; and therefore Mr. Wilson was specially well qualified to complete these works, which were cited by an eminent London gas engineer as an example of construction specially worthy the attention of the young men in the gas profession. Among other matters, he devoted much attention to the carbonization of coal in vertical retorts, as a consequence of which he patented what came to be known as the Wilson "continuous-intermittent" system. Installations on this system at Glasgow, Johnstone, and Arbroath were referred to at the meeting of the North British Association in September, 1914.

His time as Chief Engineer was a busy one, marked by the advancement of the undertaking of which he had charge, and



by a great deal of work on behalf of the industry in general. On his retirement (which followed upon his recovery from an operation on his eyes) at the end of 1919, a presentation was made to him by the officials of the various departments of the Glasgow Corporation; and Mr. Lackie, the City Electrical Engineer, in handing over the gift, paid a tribute to the work of Mr. Wilson during his thirty years' association with the Gas Department, for sixteen of which he had been Manager. He had, it was added, done everything he possibly could in the interests both of the consumers and of the corporation.

In 1905 Mr. Wilson was elected a member of the Institution of Civil Engineers; and in 1920 he was appointed an Officer of the Most Excellent Order of the British Empire for services

in connection with the war. He was a member of the Institution of Gas Engineers, of which he was President at the 1911 meeting, held in Glasgow. It will be remembered by those who were at last year's annual meeting of the North British Association of Gas Managers in Edinburgh that their respected honorary member was present. Thirty-three years before that he was President of the Association during the period when he was Manager of the Dawsholm Works. Among his other activities he was a member of the Institution of Engineers and Shipbuilders of Scotland; and during his business career he frequently contributed to discussions on most of the prominent questions connected with the gas industry.

As has already been mentioned, Mr. Wilson served his time in the Durie Foundry; and some three or four years ago, after his retirement to his native town of Leven, the Directors pleaded with him to join the Board of that undertaking. For old Association's sake he did so, and at the first Board meeting he was made Chairman. Under his wise guidance, the affairs of this Company underwent a miraculous change.

There is a touch of romance in the fact that the apprentice boy should have eventually returned to the old firm and brought with him prosperity.

There was a large representative following to pay their last respects when he was laid to rest in Scoonie Cemetery, Leven. The chief mourners included his two brothers (the younger one, John Wilson, being the London Manager of Messrs. W. & B. Cowan). There were also present Dr. Balfour Graham, Director, representing Messrs. H. Balfour & Co.; Mr. Thomas Carmichael, Chief Engineer of the Portsmouth Gas Company (representing the Council of the Institution of Gas Engineers), who received his training under Mr. Wilson in Glasgow, and Bailie Aiken, Convener of the Buckhaven and Leven Gas Commissioners.

Mr. Wilson is survived by his wife, a son (Mr. John Wilson, who is Engineer and Manager to the Motherwell and Wishaw Corporation Gas Department), and two daughters.

WALTER BOURNE BRADY.

The death has occurred of Mr. Walter Bourne Brady, late Secretary of the European Gas Company. Mr. Brady's first connection with the gas industry dates back to as long ago as 1875, when he joined the London Staff of the Continental Union Gas Company. He stayed with them until 1880, when he was appointed to the staff of the European Gas Company; the late Mr. Henry McL. Backer being at the time Chairman of both Companies.

Mr. Brady's exceptional knowledge of the French language, acquired at school in Paris, marked him for early promotion, and in 1886—that is to say, six years after joining the Company—he was appointed Assistant Secretary. In 1910 he became Secretary, which post he held till his retirement in 1919.

Deceased was for many years a member of the Société Technique de l'Industrie du Gaz en France, and often acted as interpreter for this Society, both at the congresses in France and during their visits to England. His death will be deeply regretted by his many friends both in England and in France.

We regret to have to announce the death of Mr. Henry Herbert Everest, who retired from the post of Resident Manager at the Whittington Gas-Works in 1926, after serving in that capacity for forty-two years. The Whittington gas undertaking was taken over by the Chesterfield Corporation in 1921, and is now used only for storing gas and as a showroom, under the direction of Mr. Howard Everest, a son of the deceased.

ON THE ELECTRICAL SIDE.

Hand-to-Mouth Consumers.

It is claimed by Mr. F. W. Purse, who has had long experience in electricity supply matters, that the provision of more prepayment meters is necessary, because electricity is now beginning to reach the grade of consumer who lives from hand to mouth, and can never save enough money to pay accounts quarterly. In certain classes of property, it is found, too, that more electricity is consumed if the consumers are provided with penny-in-the-slot meters than if they have shilling ones, "because frequently they have not a shilling to put in." From this statement, it seems possible that there is an opening in the electricity supply industry for the new system of monthly accounts.

A Question of Price.

The penny-in-the-slot meter, which has been so powerful an aid to the gas industry, is evidently expected to do the same for our friends; but there are limits to what it can accomplish, and a dispute which has occurred on Tyneside is one of the things that are not to be so easily settled The largest possible type has been brought into service by the local Press to announce a new turn in the power prices "battle." There have been "demands" and "challenges," and all the paraphernalia of a big fight. Comparisons which are odious have been bandied about with a freedom which must have left many people somewhat in doubt as to just "where they are." Uncomfortable as these must be in certain quarters, however, they really constitute the most interesting feature of the dispute, so far as the onlooker is concerned, because they afford a useful insight into the question of tariffs for supplies of electricity. It must be admitted that the whole thing constitutes a convincing reply to the colossal amount of advertisement that was accorded a few months ago in the news columns of the Press of the country to "farthing electricity." Eagerly at that time did the papers take up this fascinating cry; but it died down as quickly as it had arisen, and the figures quoted in this "battle" enable one to understand why. Dissatisfaction with Tyneside electricity prices has resulted in a private conference of representatives of twenty local authorities, who unanimously demanded a public inquiry into the tariffs of the Newcastle Electric Supply Company, Ltd., and the Newcastle and District Electric Lighting Company, Ltd. The resolution making this demand submitted that in the opinion of the conference the new scales of charges for shop and domestic lighting issued by the Companies are utterly inadequate to meet the necessities of the situation, and in no respect satisfy the demands of previous conferences of the local municipal authorities for an immediate and substantial reduction in the charges made by the Companies. As the new scales appear to be framed more with a view to increased consumption of energy than a decrease in the prices charged, the conference directed the completion of the formalities necessary to the deposit of an application to the Minister of Transport for a public inquiry, and that the Minister be urged to expedite the holding of such inquiry.

Here and There.

Sir George Lunn, who is Chairman of the Newcastle Parliamentary Committee, is taking a leading part in the campaign. He urges that the new charges of the Companies, so far as they affect the domestic consumer, are inadequate. "If," he says, "the basis of the old scale was 50 p.ct., or even more, above those of other towns of similar type to Newcastle—and some of them within a few miles of the city—it is no real solution of the problem to offer a reduction of 20 p.ct." An interesting sidelight is thrown upon the question of tariffs, by the statement that the domestic users of electric energy get less than 4 p.ct. of the output of the energy distributed by the Newcastle Electric Supply Company, and yet provide 20 p.ct. of the total revenue of the Company. Thus, for one-twenty-fifth of the energy they provide one-fifth of the Company's income.

As to methods of charge elsewhere, we learn that Darlington, with its own municipal supply, charges 1½d. per unit for the eight summer months, and for the four months of winter gives the consumer half of his summer consumption at 1½d. and the balance at 3½d. per unit. Sunderland charges 4d. for the first 5000 units, and 3d. per unit for all in excess of this. The price for South Shields is given as 3½d. per unit, Cardiff 3¾d., and Middlesbrough 4d. "Put these prices against the old flat rate of 6d. at Newcastle," says Sir George Lunn, "and it is evident that the 20 p.ct. reduction, even when it is obtained, does not bring Newcastle within comparable reach of Darlington, South Shields, or Cardiff. And that is not because Newcastle cannot generate electricity as cheaply as other companies."

The precise extent of the reduction to be anticipated is shown in connection with four types of houses using electricity, as set forth in the following terms in one of the Newcastle Electric Supply Company's advertisements:

Size of House.	Total Charges.		Reduction of—
	Old Basis.	New Basis.	
	£ s. d.	£ s. d.	P.Ct.
Four rooms . . .	2 19 6	2 6 9	21·4
Six rooms	4 11 0	3 13 10	18·9
Eight rooms . . .	7 13 0	6 4 2	18·8
Ten rooms	11 14 0	9 7 1	20

Into the merits of the dispute there is no need to enter here; it is referred to merely because of the interesting points that emerge. On the face of it, Newcastle, with its extremely favourable generating costs, is not where one would have anticipated an agitation against high charges; but no one knows better than a gas engineer how vastly circumstances may alter cases.

DEVON AND CORNWALL GAS OFFICIALS AT PLYMOUTH.

Visit to the Cattedown Tar Distillery Works.

Chairmen and Engineers of gas undertakings in Devon and Cornwall, at the invitation of the Directors of the Plymouth and Stonehouse Gas Light and Coke Company, paid a visit of inspection on Friday, April 19, to the Tar Distillery Works at Cattedown, Plymouth. The process of manufacture was described by the Manager of the Distillery, Mr. F. Kilpatrick, who mentioned that 700 tons of road tars were produced weekly from the tar sent there for distillation by the various gas-works in the two counties. As a central distillery they were dealing with all the gas tars produced in Devon and Cornwall, and converting them into road tars. They were also producing creosote, which was used in the preservation of timber, including all the railway sleepers required in the two counties; and the works were the central depôt for mixing and producing the National Benzole Mixture supplied for motor purposes in the district. The visitors, who were greatly interested in the inspection of the works, were later taken on a motor coach tour of the suburbs of the city, being accompanied by the Chairman (Mr. J. H. Ellis) and other Directors of the Plymouth Company.

Mr. Ellis, presiding at a luncheon held subsequently at the Royal Hotel, said his co-Directors and himself were anticipating valuable suggestions from the visitors as to what could be done to perfect the works in the public interest. They had been associated in Devon and Cornwall for close upon twelve years in the co-operative distillation of tar, and that association had been of the very greatest public advantage. It had incidentally improved their own position, as was deserved, as they had contributed money, industry, and brains for the improvement of the roads of the two counties for the benefit of the community as a whole. They had been public benefactors to a very great extent. They had killed the dust nuisance, which was such an acute difficulty ten years or more ago. They were now making roads which were not slippery, and the surface drainage from which was innocuous to fish, and their labours had been, and would continue to be, directed to that end. They had to realize that they were in the centre of a great agricultural and sporting community, and it was of the utmost importance that their roads should not merely be not slippery for vehicles, but not slippery for animals. They had attained that result. To get their organization in full working order they had a great deal to do. The greatest public question awaiting solution at the present time was that of unemployment, and the next question of importance was that the roads of the country, quite apart from the railways, which they all desired should be successful, should be suitable for the transport of commerce. Those two things went hand in hand, and towards the solution they offered their contribution, and it was a great and serious one. They claimed, as ratepayers and as traders, that the efforts they were making towards the solution of that problem should be reciprocated by those who levied the rates and taxes upon them.

After thanking the associated undertakings for electing him Chairman of the Local Association of Tar Producers, Mr. Ellis said they might congratulate themselves that in London in the course of the week the associated tar producers and distillers had asked that the system which was inaugurated in Devon and Cornwall twelve years ago should be applied throughout the country.

Mr. F. Kilpatrick proposed the toast of "The Tar Producers of Devon and Cornwall," expressing the hope that the undertakings would continue to thrive, and that the Plymouth distillery would take all the tar they could produce.

Mr. J. E. Daw, Chairman of the Exeter Gas Company, responded. He thanked the Directors of the Plymouth Gas Company for their hospitality, and for enabling the visitors to inspect the tar distillery. As the tar producers of a large district, he said, they were entitled to ask that their commodities and their work should be given fair treatment.

The visitors afterwards discussed matters of common interest at a conference held at the George Street Offices of the Plymouth Gas Company.

GAS STOCK AND SHARE MARKET.

[For Stock and Share List, see later page.]

Although business on the Stock Exchange showed no improvement last week, there was a distinct air of confidence in the markets, and were it not for the political uncertainties there would probably have been more activity. There was nothing in the Budget to affect investment securities, and the influence of the easier monetary position caused slight improvements in several British loans. War Loan touched 103; but having regard to the close proximity of the *ex* div. quotation, the price cannot be considered too high. There was a certain amount of cash selling in the Home Railway market, and prices declined in consequence.

The stock available in the Gas Market was below the average, and transactions were mostly confined to the Foreign section; but with the exception of a further rise of 1s. to 34s. 6d. (average) in Primitiva ordinary, there is nothing of importance to record. Of the Home companies the most important improvement was in the Hastings two stocks. The 5 p.ct. rose 2 points to 98-103, and the 3½ p.ct. 3 points to 80-85. Both stocks are still attractive investments. The only backward movement in ordinary stocks was ½ point in the European £10 shares to 17-19. The accounts for the year 1928 of the Colombo Gas and Water Co., Ltd., and the Hong Kong and China Gas Co., Ltd., have been received and show satisfactory results. Both companies are paying a final dividend on the ordinary shares of 10 p.ct. per annum, free of income-tax. A year ago the Colombo Company issued £19,751 bonus shares in the proportion of 1 to 4 shares held, and the dividend now recommended, though at the same rate, is on the increased capital.

The following transactions were recorded during the week:

Monday.—British 5 p.ct. deb. 95½, Commercial 98½, Continental Union 7 p.ct. pref. 124, European 17½, 17¾, Gas Light and Coke 19s. 1½d., 19s. 3d., 19s. 4½d., 3½ p.ct. 54¼, 54⅜, 55, 5 p.ct. deb. 101¼, Imperial Continental 395, 396, 398, 399, 399½, 400, Liverpool 7 p.ct. pref. 101½, Newcastle 3½ p.ct. 17s. 6d., Oriental 118½, Primitiva 32s. 3d., 32s. 6d., 32s. 9d., 33s., South Metropolitan 105, 105½, 6 p.ct. pref. 109, Tottenham 3½ p.ct. 106½. Supplementary prices, Danish 7½, Tottenham 7½ p.ct. (1931-6), 103, Yorktown and District new 5 p.ct. pref. 92.

Tuesday.—British 117¾, 118½, Commercial 98¼, Continental Union 121, 123, European 18, Gas Light and Coke 19s. 1½d., 19s. 2¾d., 19s. 3d., 19s. 4½d., 3 p.ct. deb. 59½, 59¾, 60¾, 5 p.ct. deb. 99½, Imperial Continental 396, 397, 398, 400, Primitiva 32s. 6d., 33s., South Metropolitan 105, South Suburban 110, 5 p.ct. deb. 99, Southampton 5 p.ct., 79, 79½. Supplementary prices, Cheltenham 5 p.ct. 70, 70½, Leatherhead 5 p.ct. £10 8s., Montevideo 6 p.ct. deb. 100, 100½.

Wednesday.—Continental Union 122, European 17½, 17¾, Gas Light and Coke 19s. 1½d., 19s. 2¾d., 19s. 4½d., 3 p.ct. deb. 59¾, 5 p.ct. deb. 101½, Imperial Continental 395, 396, 397, 398, 400, Montevideo 107, Primitiva 32s., 32s. 6d., 32s. 7½d., 32s. 9d., 32s. 10½d., South Metropolitan 104½, 3 p.ct. deb. 58½, 59½, Swansea 7 p.ct. pref. 101, 6½ p.ct. deb. 102, Tottenham 4 p.ct. deb. 78. Supplementary prices, Croydon 5 p.ct. deb. 97, Yorktown (Camberley) new 5 p.ct. pref. 92.

Thursday.—Alliance and Dublin 98½, Bombay 21s., 21s. 6d., Bristol 5 p.ct. max. 89½, British 5 p.ct. deb. 95½, Commercial 98¼, European 16¾, 17, 17⅜, 17¾, Gas Light and Coke 19s. 1½d., 19s. 2¾d., 19s. 3d., 19s. 4½d., 3½ p.ct. max. 64½, 4 p.ct. pref. 75¾, 76, Imperial Continental 396, 396½, 397, 398, 400, 401, Oriental 118, 119, Portsmouth 5 p.ct. max. 83, Primitiva 32s. 10½d., 33s., 33s. 1½d., 33s. 5¼d., 33s. 6d., South Metropolitan 104¾, 6 p.ct. pref. 109.

Friday.—Alliance and Dublin 98, Bombay 21s., British 5 p.ct. deb. 95½, Continental Union 122½, 123, 7 p.ct. pref. 125, European 17, 17½, Gas Light and Coke 19s. 1½d., 4 p.ct. pref. 76, 76½, 76⅞, 3 p.ct. deb. 60, 60½, 5 p.ct. deb. 99½, Imperial Continental 398, 400, 401, 402, 404, 405, Primitiva 33s. 9d., 34s., 34s. 3d., 34s. 6d., 34s. 7½d., 34s. 9d., 34s. 10½d., 35s., 35s. 1½d., 35s. 3d., 4 p.ct. con. deb. 80, South Metropolitan 104¾, 105⅜, Wandsworth, Wimbledon stock, 119. Supplementary prices, Montevideo 5 p.ct. deb. 89, Yorktown and District new 5 p.ct. pref. 92.

In Lombard Street credit was not so plentiful as is usual at the week-end, the position being possibly influenced by the heavy payments for Treasury Bills. For fresh accommodation 4 p.ct. was mostly charged, but borrowers in some instances paid 4¼ p.ct., and for renewals 4½ p.ct. Treasury Bills were allotted at an average of £5 2s. 1·07d. p.ct., which was 2s. 1·32d. p.ct. below the previous week's rate, and the lowest rate since the rise in the Bank rate on Feb. 7. Discount rates were somewhat easier.

On the Foreign Exchange Market, the New York rate moved against this country, and closed at 4.85$^{9}_{32}$; German marks were weaker at 20.47⅜; but other Continental currencies were dearer. Dutch florins were lower at 12.08$^{15}_{16}$; Spanish pesetas at 32.04½; and French francs at 124.24½. Italian lire and Belgas were unchanged.

Silver remained at 25$^{13}_{16}$d. per oz., and Gold was slightly dearer at 84s. 10½d. per oz.

The Bank Rate is 5½ p.ct., to which it was raised from 4½ p.ct. on Feb. 7. The Banks' deposit rate is 3½ p.ct., and the deposit rates of the Discount Houses are 3½ p.ct. at call and 3¾ p.ct. at notice.

INAUGURATION OF NEW GAS-WORKS AT JOHANNESBURG.

Glover-West Installation.

[An illustrated description of the new Works, situated at Cottesloe, was published in the "JOURNAL" for April 10, p. 89.]

THE OPENING CEREMONY.

The inauguration of the new Johannesburg Municipal Gas-Works at Cottesloe was performed on Wednesday, March 26, two hundred guests being present at the ceremony.

The central figure in the ceremony was Alderman F. J. West, C.B.E., M.Inst.C.E., M.I.Mech.E., Chairman and Managing Director of West's Gas Improvement Company, Ltd., of Manchester, and an ex-Lord Mayor of that city, who had come specially from England to hand over to Johannesburg the plant his firm had built.

Councillor MALDWYN EDMUND, Chairman of the Water, Gas, and Fire Brigade Committee, in asking Mr. West formally to hand over the plant to the Mayor in custody for the city, said they were in an era of great expansion in the use of gas in Johannesburg. Gas would help to expand the industries of the city. By means of the bye-products the gas-works might be of some use to the mining and farming industries. Also, they might be able, to some extent, to solve the question of petrol for motor transport. After paying tribute to the manner in which the contract had been executed, the speaker said that since the works were opened shortly before Christmas, there had been an increase in consumption of 33⅓ p.ct.

Mr. WEST, in asking the Mayor to receive the gas-works as a "going concern," said that there had been created during the performance of the contract an atmosphere of co-operation and sympathetic consideration which were essential features in all successful contracts. Mr. West expressed pleasure that it was an "All-British" job, and that while a considerable portion of the actual machinery was imported from England, approximately 40 p.ct. of the contract sum had been spent in South Africa in local work, local supplies, and local labour. His firm, he said, were fortunate in being associated with Messrs. Blane & Co., of Johannesburg, with whom the contract was placed by the municipality, and who by their advice and knowledge of local conditions had done much to expedite the work.

One was painfully conscious, he proceeded, of what might be described as the almost appalling ignorance of the public with regard to the enormous extent of the gas industry, its contribution to commerce and industry, and its suitability and economy for domestic purposes. In all quarters of the globe he had found that gas was making steady progress in spite of keen competition and development of electricity. Experience everywhere showed that gas and electricity were kindred, and thrived side by side in all places where civilized life existed. In countries and towns where competition was keenest, gas was steadily progressing in its own particular sphere. Instances could be given, particularly in some of the newer towns of the United States and Canada, where gas and electricity commenced together.

A comparison between Johannesburg and Vancouver, B.C., from the point of view of two very similar cities, was interesting. According to a photograph in the City Hall, Johannesburg in 1887 consisted of a few houses. In 1886 Vancouver became the terminus of the Canadian Pacific Railway, and consisted of a few hamlets. To-day Johannesburg had a population of 321,000, and Vancouver 322,000. The gas undertakings commenced in both cities about the same time, and the progress and development during the 19 to 20 years showed that Johannesburg had increased from an annual output of 24 million c.ft. per annum in 1909, to 109 million c.ft. in 1928. In 1909 the annual output was 102 millions at Vancouver, and it increased to 856 millions in 1928. Thus, in comparable periods, the output in Johannesburg had just over quadrupled itself, and Vancouver increased by over eight times. To-day Vancouver's output in gas was seven to eight times that of Johannesburg. In both, the gas and electricity undertakings had developed on parallel lines.

In the United States, which was admitted to be the stronghold of electricity supply, the consumption of gas per head of population was even greater than that of several large towns in Great Britain. New York, Washington, and San Francisco averaged 12,500 c.ft., against an average of 9200 c.ft. on London, Sheffield, and Bristol. The extent and importance of the gas industry was evident from the present position in Great Britain. The capital invested represented £180,000,000, and over 100,000 workmen were engaged in its activities, with an average wage roll of over £15,000,000. And to-day, as they always had been, the stock of company-owned gas undertakings ranked with the gilt-edged securities of Great Britain.

Emphasis should be placed, continued Mr. West, on the contribution the gas industry made to commerce and industry by its important bye-products in the form of coke, tar, benzole, and dyes, and the fact must not be overlooked that the successful culmination of the war was primarily due to the supply of toluole—a bye-product of the gas industry—for the manufacture of explosives. Gas had no commercial rival for the purpose of central heating, cooking, and domestic fires.

The new works, concluded Mr. West, were the "last word" in an up-to-date and model plant, and capable of extensions at the lowest possible cost.

The MAYOR, in returning thanks to Mr. West, said that the responsibility of making the gas-works a success lay with the public. Gas was going to be of the greatest benefit to the housewives of the city. It would lighten their labours considerably. From the point of view of industry the new works were evidence of the City Council's desire to foster industry within the municipal boundary.

Referring to the sliding-scale of charges introduced at the beginning of the year, the Mayor said that the only factor which would determine the future decreases in the price of gas would be the public demand. From a personal point of view the ceremony was of interest to him because his father had built the old gas-works in 1895. In conclusion, the Mayor referred to the presence of such a large company of guests in the middle of a gas-works with the plant in operation, and an entire absence of any unpleasant odour or noise.

The company then adjourned for tea.

SPHERICAL GASHOLDERS.

By S. M. MILBOURNE, A.M.I.Struct.E

INTRODUCTION.

The storage of gas in spherical containers was first introduced into America some years ago by Mr. G. T. Horton, of the Chicago Bridge and Iron Works; and now that certain British firms are prepared to manufacture and construct spherical gasholders in this country, the following communication may prove useful.

To some extent a spherical holder for storing gas under pressure is not entirely new, as the storage of comparatively small quantities of gas in cylindrical vessels has long been in vogue. The principle on which the "Hortonsphere" or spherical gasholder operates is founded on the fact that all gases exhibit a continual tendency to expand, and thus exert a pressure against the vessel in which they are confined. The intensity of this pressure depends upon the volume which they occupy, increasing as the pressure diminishes. The relationship existing between volume and pressure is defined by Boyle's Law, which states that the volume of a given mass of gas is inversely proportional to its pressure, provided the temperature remains constant. This system of storage, therefore, consists essentially of a compressor and a container. The compressor is used to force the gas from the source of low pressure into the container at high pressure, while the gas thus stored is then gradually liberated when desired. In practice, the source from which the gas is compressed is either a relief gasholder or a low-pressure gas main. The pressure at which the gas is stored varies from 30 to 60 lbs. per sq. in., but the usual working pressure for ordinary coal or water gas is 50 lbs. per sq. in. The compressor may be steam, gas, or electrically driven, preference being given to the latter when the position is somewhat isolated and the compressing unit has to be automatically operated.

The container is usually constructed of mild-steel plates of suitable thickness shaped and riveted together so as to form a perfect sphere. This is supported on chairs or cradles composed of plate and angle steel sections, which are secured to the foundation blocks with holding-down bolts. Fig. 1 illustrates a sphere in elevation and part-section.

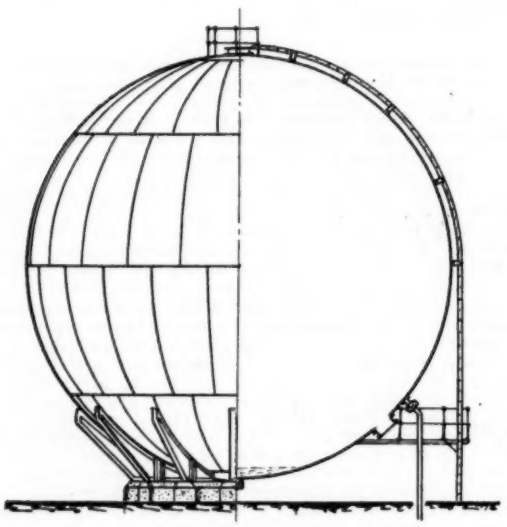


Fig. 1.

The usual fittings are as follows: Gas inlet and outlet mountings and valves, which are attached in any convenient position on the lower portion of the sphere; a drain cock for running off any condensate which may collect in the bottom of the container; at least two manholes fitted in the positions shown in fig. 1; a steel platform and ladder for giving access to the top of the vessel; pressure gauge; safety valve; and vacuum relief valve.

COMPARISON OF SIZE.

The size of the "Hortonsphere" as compared with other forms of gasholder having the same capacity at 5 to 8 in. water gauge is illustrated in fig. 2, where the various forms of holder are represented in profile: (*a*) A water sealed gasholder in steel tank, (*b*) a tankless gasholder, (*c*) a "Hortonsphere" storing gas at a gauge pressure of 30 lbs. per sq. in., (*d*) a "Hortonsphere" storing gas at a gauge pressure of 50 lbs. per sq. in. These examples indicate gasholders having a discharging capacity of 250,000 c.ft.

Though there may be some variation in the ratio of height to diameter of the tankless and water-sealed holders, the saving in

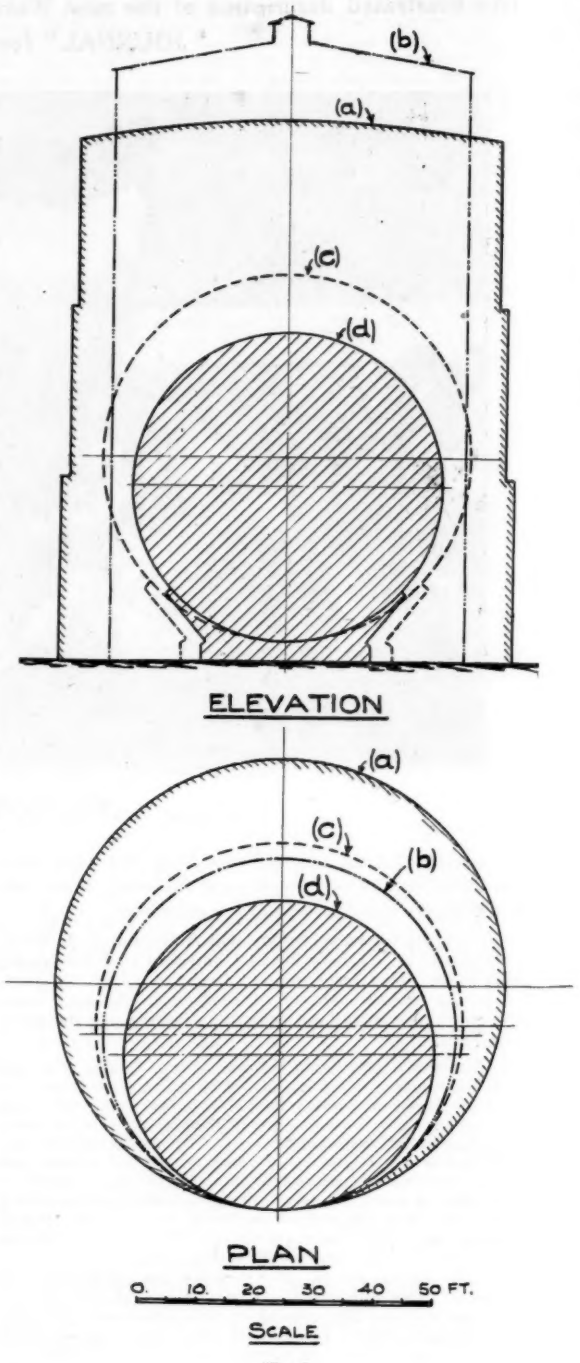


Fig. 2.

ground space and the comparatively small height of the spheres are appreciable. A table giving the relative diameters, heights, and superficial areas covered by the different forms of holder is given below. The proportions of the water-sealed holder are taken as unity.

Type of Gasholder.	Diameter.	Height.	Area.
Water-sealed . . . . (*a*)	1·00	1·00	1·00
Tankless . . . . . (*b*)	0·77	1·11	0·61
"Hortonsphere," 30 lbs. (*c*)	0·82	0·73	0·67
" 50 lbs. (*d*)	0·68	0·62	0·46

Spheres are usually constructed up to a diameter of about 65 ft., having a delivering capacity of approximately 480,000 c.ft. from a gauge pressure of 50 lbs. per sq. in. to N.T.P., or a capacity of 290,000 c.ft. from a gauge pressure of 30 lbs. per sq. in. to N.T.P. If larger capacities are required, two or more spheres may be installed. The cost of construction for all sizes

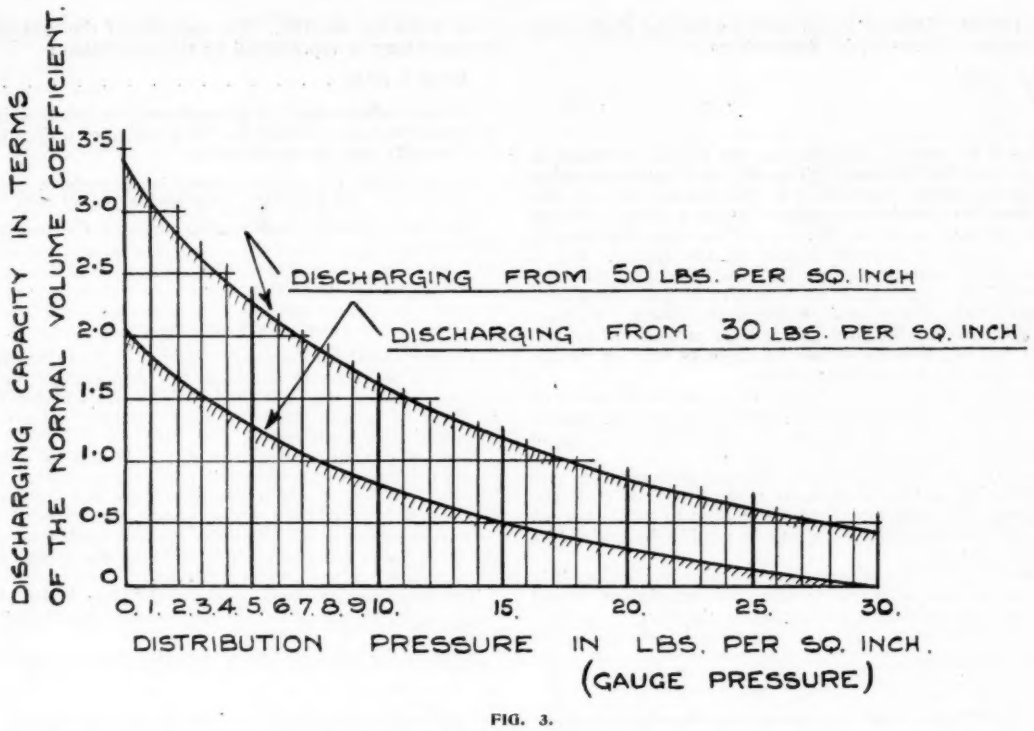


FIG. 3.

of container is fairly constant, and varies directly as the normal volume.

ADVANTAGES.

The advantages of this type of holder may be cited briefly as follows:

(1) Dry gas.
(2) Low cost of painting.
(3) Little attention required to the container.
(4) May be erected on the minimum of ground space.
(5) Uniform and well defined stresses; almost entire elimination of secondary or bending stresses.
(6) Particularly suitable for soft yielding ground, as the sphere is of small weight in comparison to its discharging capacity.
(7) Moderate subsidence of foundation not a serious matter.
(8) Pleasing appearance when compared with other forms of gasholder.
(9) No moving parts in the container.
(10) Unaffected by frost.

The disadvantages of storing gas under this system are briefly as follows:

(1) Absolute dependence upon compressing unit.
(2) Running costs of compressor.
(3) Attention required to the compressor.

The extent to which the advantages and disadvantages enumerated above influence the adoption of this type of holder in preference to other forms of storage is dependent upon the particular circumstances of each individual case; and no general rule can be given. There are two distinct applications of the "Hortonsphere" as a vessel of storage:

(1) Main storage.
(2) District storage.

In the first case, the main storage usually takes the form of one or more spheres erected on or near the works where the gas is manufactured. The gas is drawn from an ordinary relief holder at low pressure, and compressed in the spheres, after which it is allowed to enter the service mains through reducing governors, and is carried on to the district in the usual manner, at either high or low pressure.

Where the sphere is required for district storage, the usual method adopted is to draw the gas from a low-pressure main during the "off-peak" period by means of an automatically operated compressing unit. This compressor is so arranged that it is put out of action when the sphere is completely filled, or when the peak load tends to reduce the pressure in the main. A special form of governor is also fixed which allows the contents of the sphere to be discharged into the main when the pressure falls below a certain predetermined limit.

Within recent years, serious efforts have been made on the part of gas undertakings to supply gas to outlying districts, and in a number of cases where the districts are many miles distant from the source of supply high-pressure mains have proved a very effective and economical method of distribution. At present, a number of these high-pressure distribution systems are being satisfactorily accomplished by means of suitable reduction governors at various points along the low-pressure district mains; but in cases where the peak load consumption eventually becomes considerably in excess of the normal load, it will no doubt be found desirable to place pressure containers in the immediate neighbourhood, so that gas may be stored at off-peak periods from the high-pressure main, and liberated into the services as occasion requires.

CAPACITIES OF SPHERES.

The volume of gas which a container may liberate from its maximum down to its minimum pressure is known as the discharging capacity. This, however, does not include the volume of gas that would be liberated from the sphere if the compressor draws the gas supply from an independent main and is allowed to run throughout the time the container is discharging. The quantity of gas discharged under the latter conditions is known as the ultimate discharging capacity of the sphere.

The following calculations on the capacities of spheres are based on the assumptions that:

(*a*) The absolute pressure of the atmosphere is approximately 14·7 lbs. per sq. in.
(*b*) The gas conforms to the qualifications required of a perfect gas as understood with reference to Boyle's Law.
(*c*) The compression and expansion of the gas is isothermal.

Let V_1 = the volume of gas at absolute distribution pressure p_1
V_2 = the contracted volume of the gas after compression to p_2 lbs. per sq. in. Absolute.

Then the mathematical relationship between V_1 and V_2 may be stated as follows:

$$V_1 p_1 = V_2 p_2 \quad \ldots \quad (1)$$

Equating for V_1 when V_2, p_1 and p_2 are known quantities, the following is obtained:

$$V_1 = \frac{V_2 p_2}{p_1} \quad \ldots \quad (2)$$

Now the discharging capacity (Cd) of a sphere is therefore

$$Cd = V_1 - V_2 \quad \ldots \quad (3)$$

and on substituting the value of V_1 in equation (3) in terms of V_2 the following is obtained:

$$Cd = \frac{V_2 p_2}{p_1} - V_2 \quad \ldots \quad (4)$$

Now the normal volume of a sphere in terms of the diameter is $\frac{\pi}{6}d^3$

Then writing $V_2 = \frac{\pi}{6}d^3$ in (4), the following is obtained:

$$Cd = \frac{\frac{\pi}{6}d^3 p_2}{p_1} - \frac{\pi}{6}d^3$$

or

$$Cd = \frac{\pi}{6}d^3\left(\frac{p_2}{p_1} - 1\right) \quad \ldots \quad (5)$$

Then to find the diameter of any sphere when the discharging capacity is given, equate (5) for d as follows:

$$d = \sqrt[3]{\frac{6\,Cd}{\pi\left(\frac{p_2}{p_1} - 1\right)}} \quad \ldots \quad (6)$$

Now it will be seen by substituting the necessary values in equation (5) that the discharging capacity of a sphere working at a maximum gauge pressure of 50 lbs. per sq. in. and discharging into the distribution mains against a gauge pressure of 0·3 lbs. per sq. in. (8 in. W.G.) will be approximately $3\frac{1}{3}$ times the original or normal volume of the sphere. For a maximum gauge pressure of 30 lbs. and discharging under similar conditions of pressure, the quantity of gas liberated is approximately twice the normal volume of the sphere. If, however, the sphere is discharging gas at high pressure of several pounds per sq. in., then its delivering capacity will, of course, be reduced from the values given above.

The preceding graph, fig. 3, shows the capacities in terms of the normal volume coefficient of the sphere, discharging against pressures up to 30 lbs. per sq. in. for containers working at gauge pressures of 30 and 50 lbs. per sq. in.

Equations (5) and (6) are general, and may be applied for any given values of p_1 and p_2, so that, by reading directly from the pressure gauge, the quantity of gas remaining to be discharged from a partially exhausted sphere may be readily determined by applying this formula.

When deciding the size of container for district storage, it is desirable to prepare a chart showing the maximum record output of gas expected for each hour during the day.

Fig. 4 illustrates a typical chart showing hourly output at works.

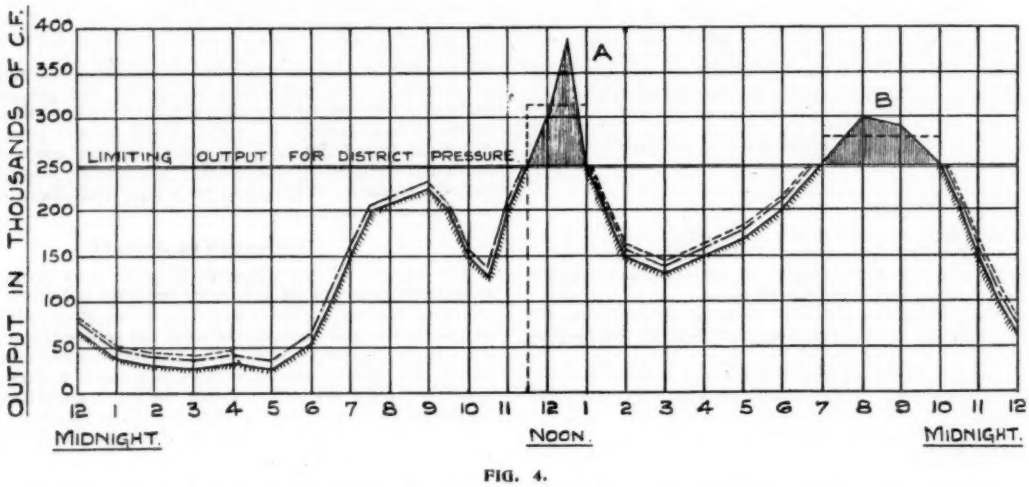


FIG. 4.

In many cases where the peak load consumption is such that a satisfactory pressure cannot be maintained at the end of the district, the installation of a "Hortonsphere" may prove useful in overcoming this difficulty.

For the purpose of example, it is assumed that when the output from the works exceeds 250,000 c.ft. of gas per hour, the pressure at the end of the district has fallen below the satisfactory limit.

From a study of the diagram fig. 4, it will be observed that from 11.30 a.m. to 1 p.m. the average output is about 320,000 c.ft. per hour, or 70,000 c.ft. per hour over the satisfactory district pressure limit.

If the lowest pressure recorded at the end of the district main is P_1 at the peak load period, and it is required to give a pressure of at least P_2, then the capacity of the container installed must be sufficient to give the difference in pressure, which is $(P_2 - P_1)$. It is a difficult matter to ascertain the exact size of sphere required, as this is dependent upon a number of indeterminate factors; but to be on the safe side and to allow for emergencies, it is permissible to allow for the whole of the output over the pressure limiting period to be taken as the necessary extra storage.

Let Cd = discharging capacity in c.ft.
S = average output per hour over the satisfactory peak load limit.
D = duration, in hours, of output over the satisfactory peak load limit.

Then $Cd = SD$. . . . . (1)

From the example under consideration, it will be seen that a second peak load period is reached in 6 hours. This should be treated in an exactly similar manner to that described above, and the value of Cd obtained; the sphere being designed to suit the maximum requirements of discharging capacity.

An alternative scheme may be considered by adopting a sphere having a capacity sufficiently great to accommodate both peak loads (A) and (B). The capacity of the container in this instance may be represented by the expression:

$$Cd\,(a) + Cd\,(b) \quad \ldots \quad (2)$$

In cases where the "Hortonsphere" is fed directly from an independent source of supply, the question of ultimate discharging capacity may be considered.

Let r_1 = the rate of charge in c.ft. per hour.
r_2 = the rate of discharge in c.ft. per hour.

Then the ultimate discharging capacity Cu is expressed as follows:

$$Cu = \frac{Cd\,r_2}{r_2 - r_1} \quad \ldots \quad (3)$$

RATE OF FILLING.

To arrive at the horsepower required to drive the compressing unit, it is necessary to find from the output chart the time that elapses between the peak-load periods and whether the sphere is likely to be completely or only partially exhausted at the termination of each period.

From the example shown in fig. 4, it will be seen that between the first and second peak loads the period of time which elapses is 6 hours, while the time from the second and first peak loads is 13·5 hours. Now provided the sphere is filled to its maximum capacity before the greatest peak load is realized, the compressor must be capable of filling the sphere sufficiently to accommodate the second peak load.

The same circumstances apply to the time which elapses and the quantity of gas to be stored from the second and first peak loads.

Now in the example under consideration, 70,000 and 30,000 c.ft. of gas per hour equal the average peak loads A and B respectively above the district pressure limit (see fig. 4).

Then if the sphere is supplied from the low-pressure district main, its capacity will depend upon the greatest peak load. Applying equation (1), the following is obtained by substituting values for A and B peak loads:

$Cd\,(a) = 70{,}000 \times 1{\cdot}5 = 105{,}000$ c.ft.
$Cd\,(b) = 30{,}000 \times 3 = 90{,}000$,,

The container will therefore be required to give a delivering capacity of 105,000 c.ft. of gas.

The size of the compressing unit in N c.ft. per hour may then be found as follows:

For peak load (A)—

$$N\,(a) = \frac{Cd\,(a)}{T\,(a)} \quad \ldots \quad (3)$$

For peak load (B)—

$$N\,(b) = \frac{Cd\,(b)}{T\,(b)} \quad \ldots \quad (3a)$$

where $T(a)$ and $T(b)$ represent the intervals of time in hours preceding the peak load periods. Substituting values from the chart

$$N\,(a) = \frac{105{,}000}{13{\cdot}5} = 7{,}780 \text{ c.ft. per hour}$$

and

$$N\,(b) = \frac{90{,}000}{6} = 15{,}000 \text{ c.ft. per hour}$$

From this, it will be seen that a compressor having a delivering capacity of 15,000 c.ft. of gas at N.T.P. per hour will be required.

In the alternative scheme in which the larger sphere is used to accommodate both peak loads (A) and (B), the time required for filling the container will be

$$T\,(a) + T\,(b) \quad \ldots \quad (4)$$

Then the number of c.ft. of gas per hour to be delivered by the compressor is expressed as follows:

$$N = \frac{Cd\,(a) + Cd\,(b)}{T\,(a) + T\,(b)} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Substituting values, the following is obtained:

$$N = \frac{105{,}000 + 90{,}000}{13{\cdot}5 + 6} = 10{,}000 \text{ c.ft. per hour.}$$

The example and chart fig. 4 represent a gas output where two excessive peak loads occur within 24 hours, but in cases where only one such load is experienced during a day, there is obviously only one scheme so far as the storage capacity and compressor delivery capacity are concerned. In some instances, heavy peak loads are experienced only on certain days, once or twice per week, in which case the compressor may be permitted to take a few days to fill the container. Where the district is somewhat scattered, two or more spheres may be required at certain points along the main, but the method of working remains much the same in all cases.

Before finally deciding the size of compressor to be used, it is necessary to bear in mind that the output between the peak load periods will be increased on account of the gas which is drawn from the main by the compressor. In consequence, the period in which the compressor will operate at its maximum capacity is reduced. If the peak load approaches or leaves the district pressure limit line steeply, then the original period over which the compressor works at maximum capacity will not be affected to any appreciable extent. On the other hand, if the line of peak load approaches or falls away obliquely to the district pressure limiting line, the allowable period at which the compressor may develop its maximum capacity will be reduced. These circumstances are illustrated in fig. 4 by dotted lines, the ordinates of which measured from the original output graph represent the additional quantity of gas in c.ft. per hour taken into pressure storage at the off-peak periods. The ordinary dotted line represents the additional output for the first scheme, whereby the sphere is filled between each peak load daily. The chain dotted line indicates the output for the second scheme, in which the larger sphere is used with a compressor working continuously throughout the off-peak periods. In cases where such off-peak periods are appreciably reduced, the hourly capacity of the compressor must be increased accordingly, to compensate for the loss in time.

Horsepower of Compressors.

Now it will readily be understood that, though a definite amount of work is performed in filling a sphere with a given quantity of gas, the horsepower of the compressor may be varied considerably, and is dependent upon the time required for filling. When gas is compressed, two classes of work are performed:

(*a*) Work done in compressing the gas (external).
(*b*) Work done in raising the temperature (internal).

The internal work (*b*) tends to increase the pressure or the volume of the gas, and, consequently, is wasteful of energy. In most compressing units, the gas compressing cylinders are water cooled, and by this means a large portion of the internal work is withdrawn, allowing the compressed gas to conform more nearly to isothermal conditions. The isothermal conditions of expansion or contraction of a perfect gas may be expressed as follows:

$$pV = C \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Where p = Absolute pressure of the gas
V = volume of gas at pressure p
C = a constant.

From this, it follows, therefore, that the total work done (W) in compressing a certain volume of gas from V_1 to V_2 may be given by the integral

$$W = C \int_{V_2}^{V_1} \frac{dV}{V} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

which on integrating becomes

$$W = C\,(\log_e V_1 - \log_e V_2) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Then the actual work performed (W_1) in ft. lbs. per sq. in. against compression will be

$$W_1 = C\left\{\log_e V_1 - \log_e V_2\right\} + \left\{V_2\,(p_2 - p_1)\right\} - p_1\,(V_1 - V_2) \quad . \quad (4)$$

where p_1 = the Absolute pressure of the gas entering the compressor,
and p_2 = the Absolute pressure of the gas after compression.

Substituting the value of $V_2 = \frac{V_1 p_1}{p_2}$ and cancelling the last two terms of the above expression, the following is obtained:

$$W_1 = C\left\{\log_e V_1 - \log_e\left(\frac{V_1 p_1}{p_2}\right)\right\} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

Then writing $C = p_1 V_1$ and inserting N (the capacity of the compressor in c.ft. of gas per hour) = V_1 in equation (5), the horsepower required may be expressed as follows:

$$\text{H.P.} = 1{\cdot}675 \times 10^{-4}\, p_1\, N \log_{10} \frac{p_2}{p_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (6)$$

Applying the above formula to obtain the horsepower required to compress 1000 c.ft. of gas per hour from any pressure p_1 to p_2 then

$$\text{H.P.} = 2{\cdot}5 \log_{10}\left(\frac{p_2}{p_1}\right) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (7)$$

Therefore in the case of a compressor required to deliver n thousand c.ft. of gas per hour from an initial gauge pressure up to 8 in. W.G. into a spherical holder working at 50 lbs. per sq. in. (where k = the efficiency of the compressor expressed as a fraction of unity), the maximum horsepower required will be

$$\text{H.P.} = \frac{1{\cdot}6\,n}{k} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

Also the maximum horsepower required to deliver n thousand c.ft. per hour under the same conditions as above, but into a container working at 30 lbs. per sq. in. gauge pressure will be

$$\text{H.P.} = \frac{1{\cdot}2\,n}{k} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8a)$$

Now it will be observed that, as the sphere is filled, the horsepower exerted is not a constant factor, but increases as the pressure in the container rises, until the maximum value is reached. This rate of increase, however, is influenced by the variation in the efficiency of the compressing unit. Fig. 5A indicates graphically the approximate efficiencies for the various types of compressing units delivering gas against pressures up to 60 lbs. per sq. in.

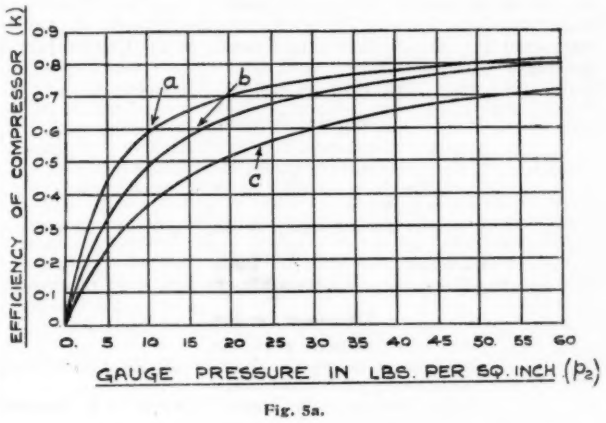


Fig. 5a.

Curves (*a*), (*b*), and (*c*) represent the pressure-efficiency graphs for electrical, steam, and gas driven compressing units respectively. The values given include for the mechanical efficiency of the engines and motor as well as the compressors.

The cost of compression is based on the average power developed over the period the plant is running. Fig. 5B represents graphically the results obtained from equation (7) after including for the efficiency.

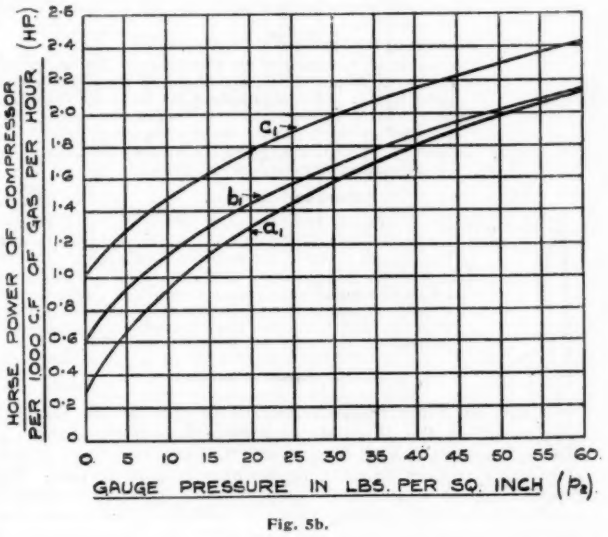


Fig. 5b.

Curves (a_1), (b_1), and (c_1) indicate actual horsepower required per 1000 c.ft. of gas per hour (compressed from a few inches W.G. up to a gauge pressure of 60 lbs. per sq. in.) for the three types of compressing units in the order previously stated. The average horsepower developed for any type of unit may therefore be obtained by graphic integration of the particular curve between the limiting values of pressure. In the case of con-

tainers having a nominal working pressure of 50 and 30 lbs. per sq. in. the maximum and average horsepower values are tabulated below:

Nominal Pressure of Container.	50 Lbs.	30 Lbs.	Difference.
Electrically driven compressor, maximum horsepower	2·0	1·6	67 to 68 p.ct.
Electrically driven compressor, average horsepower	1·36	1·07	
Steam driven compressor, maximum horsepower	2·02	1·67	75 to 76 p.ct.
Steam driven compressor, average horsepower	1·52	1·27	
Gas driven compressor, maximum horsepower	2·3	1·98	78 to 81 p.ct.
Gas driven compressor, average horsepower	1·8	1·6	

These figures must be treated as approximations, owing to variations of efficiency in different sizes and makes of compressing plant; but generally speaking these results are sufficiently accurate for most practical purposes.

(To be concluded.)

BRITISH COMMERCIAL GAS ASSOCIATION.

Scottish and Midland District Conferences.

The following is the programme of the Midlands Conference, which will be held in the Board Room of the Cheltenham Gas Light and Coke Company, North Street, Cheltenham, on Thursday, April 25. Mr. A. H. Wyatt, Director of the Company, will preside.

MIDLANDS CONFERENCE PROGRAMME.

Morning Session.

Subject: "Gas in Relation to Public Health."

11.0 a.m. 1. Opening remarks by the President of the Conference.

2. "Health in the Home," by Dr. R. Bute Macfie, O.B.E., M.B., B.Ch.

3. "Every Town a Health Resort," by Mr. C. W. Welford, A.S.A.A.

Discussion.

1.0 p.m. Adjournment for luncheon at the Queen's Hotel, Cheltenham.

Afternoon Session.

3.0 p.m. A Public Lecture in the Town Hall.

"Sunlight and Health," by Dr. C. W. Saleeby, F.R.S.(Edin.), Chairman of the Sunlight League.

Opening remarks by the Mayor, Alderman C. H. Margrett, C.B.E., J.P.

The Scottish Conference will be held in the Cowdray Hall, Schoolhill, Aberdeen, on Thursday, May 2, when Councillor George Catto, Convener of the Aberdeen Corporation Gas Committee, will take the chair. For this Conference the following programme has been arranged.

SCOTTISH CONFERENCE PROGRAMME.

Morning Session.

10.30 a.m. Official welcome by Andrew Lewis, Esq., LL.D., Lord Provost of Aberdeen.

Remarks by the President of the Conference.

Discussion on "Service to the Consumer." To be opened by Mr. S. Milne (Engineer, Aberdeen Corporation Gas Department). Followed by Mr. J. W. McLusky (Glasgow), Mr. J. Dickson (Dundee), Mr. G. Keillor (Greenock), Miss Gompertz (Cookery Demonstrator), and others.

12.45 p.m. Adjournment to Palace Hotel for lunch, at the invitation of the Aberdeen Corporation Gas Department.

Afternoon Session.

3.0 p.m. Subject: "Gas in Relation to Public Health," by J. Parlane Kinloch, Esq., M.D., D.P.H. (Chief Medical Officer, Department of Health for Scotland, Edinburgh).

Discussion to be opened by Councillor John S. Doeg (Convener, Aberdeen Public Health Committee). Followed by Councillor Henry Alexander (Convener, Aberdeen Town Planning and Industrial Development Committee), and others.

Safety in Mines Research Board.—As part of the research programme of the Wire Ropes Committee of the Safety in Mines Research Board, a specimen is examined from practically every colliery winding rope which fails in service. The information so acquired is supplemented by examination of specimens cut off winding ropes at recapping. A paper has just been published under the title of "The Deterioration of Colliery Winding Ropes in Service," by Messrs. S. M. Dixon, M. A. Hogan, and J. M. Robertson (Safety in Mines Research Board Paper No. 50, H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, price 1s.), which gives descriptions of a number of typical failures, and discusses the factors that operated to cause the deterioration of these ropes. Fatigue or failure by slow fracture was found to be the most common influence.

STEAM STORAGE ON GAS-WORKS.

Ruths Accumulator System.

An order for a Ruths steam storage plant has recently been placed by the Gas Light and Coke Company for their Brentford Works. These works are now being entirely remodelled, and when completed the steam plant will consist of three stoker-fired water-tube boilers, and four waste-heat boilers situated in the vertical retort house, which will generate at 160 lbs. per sq. in. and a final temperature of 500° Fahr. In addition, there will be three waste-heat boilers operating in conjunction with the water gas plant, generating at 100 lbs. per sq. in. and a final temperature of 338° Fahr.

The high-pressure steam will be supplied to the boiler auxiliaries, feed pumps, &c., and the low-pressure steam to the electric generating plant, turbo gas exhausters, and other works consumers. The accumulator will be connected to the branch line between the high-pressure and the low-pressure mains, and the steam supply to these mains will be controlled by Ruths automatic valves. The over-all length of the accumulator shell will be 55 ft. 6 in., and the diameter 13 ft. 10½ in.; and it will be designed to operate between pressures of 160 lbs. and 100 lbs. per sq. in., which will give a maximum discharge of 12,000 lbs.

A factor which is closely considered in connection with a steam storage plant is the reduction to a minimum of radiation losses from the accumulator; and the shell in this case will be covered with 3½ in. of insulating material, consisting of 85 p.ct. magnesia, over which will be placed ½ in. of asbestos cement, weather-proofed by a suitable external covering. The covering of all joints and rivets will be carried out separately, to facilitate removal for inspection.

The automatic control valves to be fitted are of a double-seated balanced type, with cast-steel bodies and alloy-steel seats of special design, to prevent wire-drawing. Each valve will be equipped with a servo-motor, automatically operated by oil pressure, which is controlled by a relay actuated by the pressure to be regulated. The valves will be equipped with an emergency trip and hand-wheel for hand operation.

The control panel of the accumulator installation will include gauges to indicate and record the pressures in the high-pressure and the low-pressure mains and in the accumulator. A firing gauge will be placed in the boiler room which will indicate to the firemen the pressure variations in the accumulator, and also give ample warning should the accumulator, under abnormal conditions, become completely charged or discharged, thereby necessitating an alteration in the rate of firing.

The decision to instal a Ruths accumulator followed upon the successful results achieved by the Gas Light and Coke Company at another of their stations—Bromley-by-Bow—where the load conditions are comparable with Brentford. At Bromley a Ruths accumulator has been in operation for the past two years.

Selection of Coal for Gas Producers.—At a meeting of the Society of Glass Technology on March 20, Mr. E. J. C. Bowmaker presented a paper, compiled in collaboration with Mr. J. D. Canwood, stating that laboratory tests were carried out on some two dozen coal samples, and the results obtained were compared with the performances of the coals in actual use in the producers. The following specification was given for a good producer coal: Ash not to exceed 7 p.ct.; volatile matter 35-38 p.ct.; solubility in aniline not to exceed 7 p.ct. under conditions stated; the iron oxide content of the ash not to exceed 15 p.ct. The last figure was liable to variation according to the method of working the producer.

National Physical Laboratory's Annual Report.—An innovation is being made this year in publishing the reports of the various Departments of the National Physical Laboratory as separate documents, as well as in the complete report. This refers also to a new feature of the report which should prove of considerable interest—viz., a section giving an account of "The Units and Standards of Measurement employed at the National Physical Laboratory." The following separate sections will be published shortly: Physics, electricity, meteorology, engineering, aerodynamics, metallurgy, and units of standards of measurement. The complete report for 1928 is obtainable at H.M. Stationery Office, Adastral House, Kingsway, W.C. 2, price 9s. net.

Heat Treatment of Metals.—Dr. C. M. Walter (of the Industrial Research Department, Birmingham Corporation) addressed the Birmingham Branch of the Institution of Productive Engineers on Wednesday, April 10, on "Heat Treatment from the Productive Engineers' Standpoint." The increase in the use of gas for industrial purposes, said Dr. Walter, was enormous. Last year's figures showed an increase of 238 million c.ft. in the consumption of gas for the heat treatment of metals, the total consumption now reaching 2860 million c.ft. The Birmingham Gas Department had placed its laboratories at the disposal of manufacturers for testing methods of heat treatment. Dr. Walter dealt with heat treatment as a process in the manufacture of steel components, and pointed out the importance of accurate temperature regulation and control in heat-treating operations.

LONDON AND SOUTHERN DISTRICT JUNIOR GAS ASSOCIATION.

Visit to the Lea Bridge Works.

A considerable number of members of the London and Southern District Junior Gas Association assembled at the Works of the Lea Bridge Gas Company on Saturday afternoon, April 13, to make a tour of inspection of the works under the direction of their President, Mr. W. Trevor Kenshole (Assistant Engineer of the Lea Bridge Company). The members were received on arrival by Mr. F. W. Cross, M.Inst.C.E., General Manager of the Company, Mr. D. Cleave Cross, A.M.Inst.C.E., Engineer and Works Manager, Mr. Henry Hand, the Secretary, and Mr. Kenshole.

The Lea Bridge District Gas Company was formed in 1868, when the works were purchased from the County and General Gas Consumers' Company. The Company supplies the districts of Walthamstow, Highams Park, and part of Leyton. In 1928 the make of gas was 992 million c.ft.; the number of consumers, 35,631; and the capital, £29,675. The total mileage of mains on the district is 118 miles, and the total area of the works is nearly 15 acres.

All the coal used comes from South Yorkshire, and is received by rail. The wagons are placed on a private siding at the back of the retort houses, where they are discharged into hoppers and elevated either into stores or the vertical retort house hoppers.

Vertical Retort House

(capacity 1¾ millions per day).

This house was erected by West's Gas Improvement Co., Ltd., in 1914. Four settings with eight retorts in each were then built, and two further settings were erected in the same house in 1920. The retorts are 2 ft. 9 in. by 10 in. at the top, tapering evenly to 3 ft. 3 in. by 18½ in. at the bottom and 21 ft. long. The throughput of coal per day for the six beds is about 130 tons, or 2·9 tons per retort per day. Each setting has a separate producer, and is so arranged that one-half (4 retorts) can be worked alone as a unit. The producers are of the usual step grate type. The coke extractor gear is operated by wire ropes, the power being obtained from two 10 H.P. National gas engines worked in duplicate.

The retorts are steamed to give a quality of nearly 505 B.Th.U., and a make per ton of about 14,800 c.ft. The coke extracted is discharged from the retorts every 1½ hours into telpher skips, and run out to the front of the house on to turntables under the telpher conveyor.

A new vertical retort installation is now in the course of construction by West's Gas Improvement Company. This house is designed to hold eight settings with 8 retorts in each setting of the new 40-in. model retorts with steaming chamber, and a complete waste-heat recovery plant. The whole house, when completed, will have a capacity of 4¼ million c.ft. per day of 510 B.Th.U. Though all the steelwork, coal hoppers and coaling plant are to be installed for the eight settings, at present it is the intention only to build five of the settings of brickwork, giving a capacity of 2⅜ million c.ft. per day. A Henry Lees 20-ton wagon tippler is to be installed to deal with the coal for this house.

Inclined Retort House

(capacity one million per day).

This house was erected in 1899, and contains eight settings of 8 retorts each. The retorts are set at an angle of 32°, and are 20 ft. long. They taper from 18 in. by 15 in. at the top to 24 in. by 15 in. at the bottom. There is a separate hydraulic main to each setting, with an adjustable liquor seal pot to each. The gas passes away through two retort house governors. All the furnaces are being fitted up with the "Sydenham" grate. The inclined retort benches are now only acting as a stand-by, and are to be demolished as soon as the new vertical house is at work.

Telpher Conveyor.

The telpher system runs practically the length of the works, and conveys the whole of the coke in bottom opening skips, from the vertical retort house to either the coke yard or water gas plant. It was built by Messrs. Strachan & Henshaw, Ltd., in 1914. The total length is 733 ft., the height of rail above ground being 32 ft.

The coal gas is cooled before passing to the exhausters in two

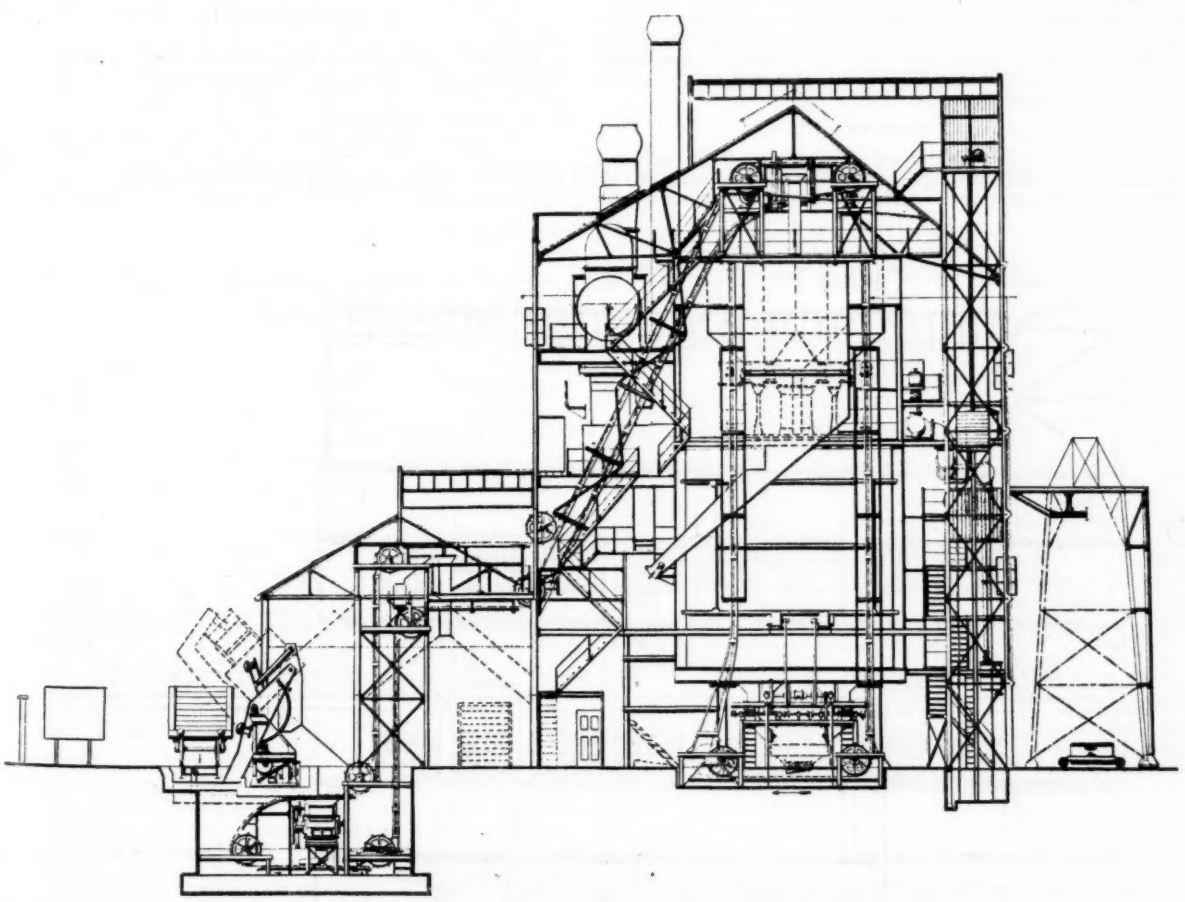


FIG. 1.—TRANSVERSE SECTION OF GLOVER-WEST RETORT HOUSE,

With coal-handling plant, comprising side-discharging wagon tippler, coal breaker, and conveyor for coal store and retort house. Coke elevator to producer-feed hopper, waste-heat boiler, lift to stage floors, and telpher transporter to coke yard.

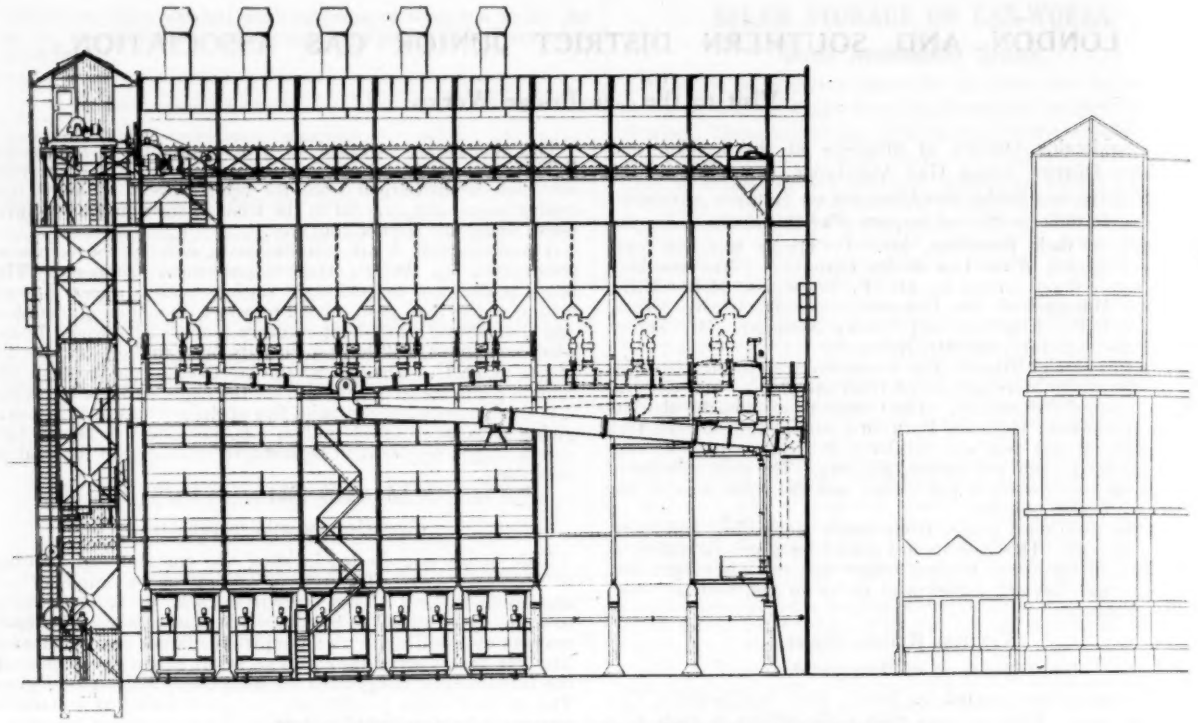


FIG. 2.—LONGITUDINAL SECTION OF GLOVER-WEST RETORT HOUSE.

one-million Clapham's "Eclipse" reversible water-cooled tubular condensers.

There are two twin sets of four-blade exhausters driven by steam engines of Messrs. Waller's design. The smaller set has a capacity of 100,000 c.ft. per hour, while the larger set at present is 130,000 c.ft. per hour, but the engine, connections, and foundations have been installed for a future of 200,000 c.ft. set of exhausters.

There are two 39 KW. dynamos driven by Sisson's 12 in. by 7 in. high-speed steam engines running at 500 R.P.M. The current generated is D.C., and is used for driving the coaling plant, the vertical retort house lift, the telpher, and pan breeze plant. It is proposed this summer to add a new 80 KW. set for the new retort installation.

WASHERS.

The gas, after leaving the exhausters, passes through two two-million Livesey washers, a Pelouze and Audouin tar extractor, and then through two Holmes' horizontal rotary washer scrubbers worked in parallel. The ammoniacal liquor from the condenser is collected separately and circulated through the washer scrubbers and washers.

The purifiers are in one block of four, 30 ft. square by 6 ft. deep, with one 30 ft. by 30 ft. by 6 ft. check purifier. The covers are jointed with rubber, and held down by Milbourne's fasteners. The four purifiers are fitted with Milbourne's Duplex valves, and the catch-box with a Trinity valve.

CARBURETTED WATER GAS PLANT.

The water gas plant was erected by Messrs. Humphreys & Glasgow, Ltd. There are three carburetted sets—viz., 1, 1½, and 1¾ million c.ft. per day. The two larger sets are coupled with a waste-heat boiler installed in 1922.

The water softening plant erected specially for the waste-heat boiler is of the "Lassen Hjort patent automatic type." The water is received from the condensers at about 140° Fahr., containing about 17° to 22° of hardness, and is then reduced to

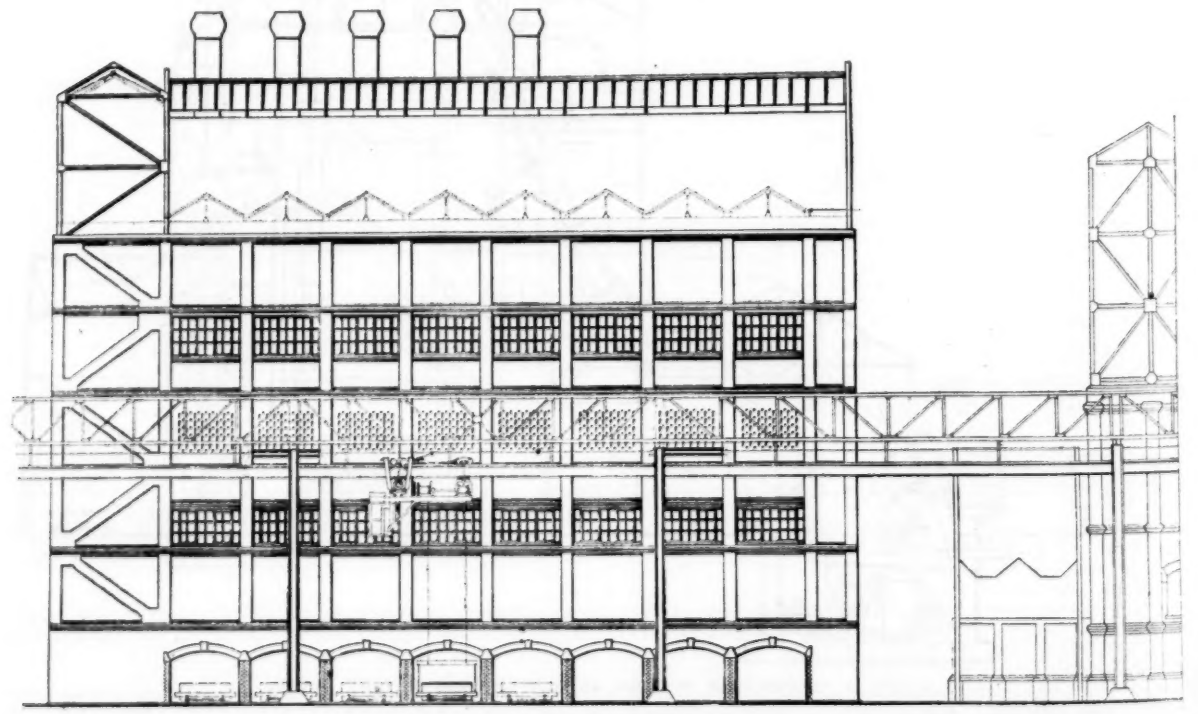


FIG. 3.—LONGITUDINAL ELEVATION OF GLOVER-WEST RETORT HOUSE.

1° to 2° hardness by a prepared "Sofnol" mixture of lime and soda ash.

Two oil storage tanks adjoin the plant, having a capacity of 106,000 galls.

Water Gas Exhausters, Purifiers, and Meters.

From the relief holder the gas is exhausted by either of two 80,000 c.ft. Waller's four-blade exhausters, with belt drive from two Crossley gas engines of 16 and 20 H.P. The water gas passes through a two-million Livesey washer, extracting light oils, and thence to four 25 ft. by 20 ft. by 6 ft. purifiers. These are constructed with Walker's rubber joint and Milbourne's patent fasteners.

The water gas is registered by two 80,000 c.ft. Thorp's rotary meters. The first was installed in 1911, and has worked satisfactorily. The water gas is mixed with the coal gas at the inlet of the gasholders.

Gasholders.

The gas storage capacity, usually expressed as a percentage of the maximum day's output, is now approximately 78 p.ct. The total storage capacity is 3½ million c.ft., and the maximum 24 hours' output for last year was just over 4¼ million c.ft.

Sulphate of Ammonia and Effluent Water Plant.

The sulphate plant is of the Wilton's closed saturator type, and is designed to make 3 tons of sulphate per day. Owing to the difficulties in disposing of the effluent liquor, the plant has been shut down for the last seven years, and all liquor is sent away by rail.

The whole of the works effluent water is brought to one point, where it is made to pass through a series of shallow channels containing a number of wood wool filters. The filtered water is collected in a brick tank from which it is pumped over a Visco air cooler before passing through further filters, after which it is discharged into the Dagenham Brook.

After the inspection the party were entertained at tea at the invitation of the Directors of the Company; Mr. F. W. Cross presiding.

Mr. F. W. Cross, in welcoming the Association once more to the Lea Bridge Works, recalled the fact that it was nearly 27 years since they paid their first visit, though they had been there again in the year 1923. The Company had progressed very considerably since then. When he entered the works in 1896—33 years ago—the annual make of gas was only 90 million c.ft. To-day it was a thousand million. He went on to congratulate the members in giving up their Saturday afternoons to visit gas-works when they were in gas-works all the week, and he hoped that they would be able to say that they had seen some novelties on these works in the course of the tour on that occasion, which had, perhaps, given them some ideas which they might sometime incorporate into their own plant. Mr. Cross stressed the indebtedness of the manufacturers to the engineers; for the former might bring out some new plant and instal it on the works, but it remained for the engineers who had to live with the plant to suggest improvements here or there, and thus help to overcome any shortcomings that there might be in the apparatus. In conclusion, he would like to say how glad he and his fellow Directors were to welcome the Association to Lea Bridge, and hoped it would not be long before they paid them another visit. He would also like to take this opportunity of congratulating his Assistant, Mr. Kenshole, upon his being President of the Association. The Lea Bridge Gas Company had now supplied three Presidents to the Association—namely, Mr. D. Winslow; his son, Mr. D. C. Cross; and now Mr. Kenshole.

Mr. W. Trevor Kenshole (President) thanked Mr. Cross for his remarks, and said what a pleasure it was to have him there that afternoon with his good advice. During the course of a visit such as had been made that day one always learnt something. He would like to draw attention to the fact that the whole of the carbonization at the works was in vertical retorts (the inclined retorts being kept as a standby, and would go directly the extension of the new verticals were completed). Lea Bridge was one of the first gas-works in the South of England where vertical retorts were erected. For a works of their size they had quite a good lay-out, with a comparatively small plant for the disposal of the effluent water, the flow of which finally went into the River Lea. The River Conservators were perfectly satisfied with the tests made.

Mr. F. S. Larkin (Senior Vice-President) proposed a vote of thanks to the Directors and Officers of the Company for their kindness to them that afternoon. He spoke of the remarkable progress of the gas industry; it never stood still. He would like to refer to the cleanliness observed on the works and the very efficient telpher system serving all parts. There was evidently a strong bond of union between the Association and the Lea Bridge Company as was evidenced by the number of visits paid. He advised the members to take the advice given by Mr. F. W. Cross, and try to incorporate the details seen that afternoon in their own business. He wished to include in the vote of thanks the names of Mr. W. J. Brand, Mr. M. Walker, and others who had assisted as guides and had added interest to the visit.

Mr. H. C. Sims (South Metropolitan Gas Company) seconded the vote.

Mr. D. Cleave Cross (Engineer and Works Manager), in reply, thanked the members for their kind expression. One felt, he said, rather reticent in going round a works of this size after inspecting the great London works and seeing the colossal machinery. Reference had been made to the cleanliness observed. That, in his opinion, made for efficiency. That and social welfare among the employees were among the outstanding features of the Company. He could assure them they were a happy family and not a collection of units.

Mr. H. Hands (Secretary) said he would convey the expression of thanks to the Directors. He was proud to be the Secretary of such a progressive Company. Owing to their low capital costs they were able to supply gas at a very low price, and they hoped to bring the price even lower shortly.

HEAT CONTROL OF CONTINUOUS VERTICAL RETORTS.

By F. J. Bengough, Carbonizing Superintendent, Nechells Gas-Works, Birmingham.

Mr. F. Caudwell (Shrewsbury) presided on Thursday, April 18, at the last meeting of the session of the Midland Junior Gas Association at the Council House, Birmingham.

The well-known advantages of vertical retorts—viz., high thermal yield, elasticity in operation, improved yield and quality of residuals, and reduced labour charges—are not obtained continuously over a number of years from the same settings without careful and detailed supervision. Care and patience in the initial stages are especially repaid in the later results.

I therefore propose to detail the method of procedure from the lighting of the first fire to the drawing of the last fire in a setting in which silica is used. I do not intend to make the paper an account of work done or a description of any particular plant; and though I shall deal with a setting of Woodall-Duckham retorts having end producers, I shall omit any figures or detailed drawings which might suggest that the recommended method is exclusive to any one plant, as with slight modifications it is applicable to most settings, especially those fitted with end producers. The treatment of settings having internal producers is straightforward, and, as this type is most common, should be familiar to all students.

Contractors' Guarantees.

It is the usual practice for the gas engineer to insert a clause in contracts for the erection of settings to the effect that the contractors shall give a guarantee of the results to be obtained, such guarantee to be fulfilled within the first six months' working; the contractors being responsible for the drying, lighting-up, and general working of the plant during this time. Though the gas engineer is then largely clear of responsibility in the matter, it is doubtful if it is the right policy. On all contracts the contractors set aside a certain sum for the expenses and upkeep of their carbonizing staff, who must, if they can, show a profit. The tendency is, therefore, to rush the guarantee through, knowing that the gas engineer will then usually release the contractors' staff and allow them to leave the job. The contractors may fulfil their guarantee quickly, but it may be at the expense of the life of the setting and its later thermal yields; and it behoves the gas engineer to know how the setting should be started up, so that it has fair and careful handling at the most critical time of its life.

I should, therefore, recommend that the setting be dried out, lit up, and worked during the guarantee period by the engineer to his own satisfaction, under the supervision of the contractors' carbonizing staff. Should any trouble be experienced during this time or at a later date, the responsibility will be largely the contractors'; but the engineer will have the satisfaction of knowing exactly what has taken place to cause it.

Expansion of Silica.

The use of a deep belt of silica in retorts is becoming a general practice because, owing to its better refractoriness and greater heat conductivity, it shows a saving on fuel and speeds up the rate of carbonization, so increasing the capacity of existing plants and avoiding the erection of additional gas-making plant. The retort life is also longer—*i.e.*, it will carbonize more coal before needing repairs—because silica offers a greater resistance to abrasion by coke or attack by salty coal or flue dust.

The only doubtful point about silica is to know exactly what provision to allow for after-expansion, as this depends upon the degree of conversion of the quartz, which may vary with each kiln of bricks, due to slight differences in the temperatures of burning periods. It is considered best to assume that complete

conversion has not taken place in the kiln, and that this conversion process has to be completed in the setting; and, since all the silica cannot be raised to the same temperature at the same time, trouble will be caused by unequal expansion unless the conversion is completed slowly and very carefully.

The percentage of expansion given by the silica manufacturers should be carefully confirmed by the contractors by means of laboratory experiments and practical experience, and the necessary allowances calculated for the various temperatures at different parts of the setting. Cavities having been left, steps must be taken to keep them quite clean; and this is usually done by placing sheets of corrugated cardboard in them. The setting then becomes virtually a solid mass until the cavities are restored by the burning-away of the cardboard. Now the maximum expansion of most of the silica in the setting takes place before the silica adjoining the cavities has reached the ignition-point of the cardboard, so that if the cavities have been calculated and left to absorb all the expansion, any movement at this stage, beyond that sufficient to crush the corrugations in the cardboard, must pass on to the side flues and boundary walls. These walls will bulge or crack under the strain, or, if the bracing prevents their so doing, the expansion will be dispersed by cracking or bulging somewhere in the setting, so that later, when the temperature has increased and the cardboard has burnt out, the cavities then left may be too big to be taken up by the remaining expansion, and will remain, allowing the setting at its maximum temperature to grow into it and cause some of the vertical joints in the setting to open. Therefore, if the cavities can be kept clean by any other means, such as temporary wooden filling, it is much better.

Construction.

A few points needing attention during the construction are worth mentioning. When the refractory materials used in the construction are delivered they should be kept away from other materials likely to contaminate them, such as lime, ashes, flue dust, metal swarf, &c., and the silica material must be kept dry.

Samples of each delivery of bricks and jointing should be taken and tested, each being kept separate until the result of the test is known, in case the sample is not up to specification standard. Should a further sample confirm the poor original test, the matter can be taken up with the manufacturers. When erection commences the bricks and specials used should be watched for shape, size, and quality, to see that they are up to the standard of the samples tested. Only sufficient jointing cement must be used just to fill the joints, and frequent samples from the bricklayers' cement boxes should be taken and tested. If the jointing being used does not work well, it is a great temptation for a bricklayer to add just that pinch of Portland cement necessary to make the jointing work well; but this will be sufficient to cause fusing of the joints at a later date.

Temporary wooden covers should be placed over all small and inaccessible flues during their construction whenever work on them is suspended while the other work is being done.

As it is always the custom for the tongue of tongued and grooved bricks and specials to be laid facing downwards, any dressing of the bricks necessary to conform to levels should be done on the grooved side, as this, being uppermost, can be seen and inspected better.

The engineer should inspect the work frequently to see that it is being carried out in agreement with the detailed drawings, this being most important in the case of the expansion cavities.

Final Inspection.

The construction finished, all flues must be examined to ensure their being tight and clear of obstructions. This should not be left entirely to the contractors' man, but should be conscientiously confirmed by the gas engineer, because, after firing, a partial blockage may be found which can only be cleared from the inside. As it is usual for settings to be under fire for at least four years, in such a case the setting will have to be working at a reduced efficiency for this time. Wherever possible all flues should be individually explored and inspected from the inside, while the smaller ones, such as the primary air, secondary air, and regenerator flues, and the combustion chambers should be examined by passing a small electric light on a flexible lead through them. All damper lids, cleaning box lids, and retort manlids and covers are now put on, and the retort bottom doors shut and sealed in water. All the bracing should be examined to see that it is tight, and, if necessary, wooden packings placed behind any of the bracing which is not absolutely in contact with the brickwork.

Description of the Plant.

It would be as well, at this point, to give a few details of the particular plant on which the following method has been tried and adopted. There are four ranges of Woodall-Duckham retorts, and each range, consisting of thirty-two retorts, is divided into two at the middle by the chimney and waste-heat boiler flues; each half range being separately fed from end producers. Four step-grate producers fitted with double clinkering doors and special steam air injectors are situated at each end and so arranged that each quarter range has its own two producers, the primary air to each pair being controlled by separate steam reducing valves. The steam air injectors have been fitted to obtain sufficient forced draught under the grates to enable breeze to be used as a fuel. There are two producer gas offtakes behind the curtain wall of each producer, the gas passing over a damper in them into the flues in the side walls of the setting, from which it rises to each side of each retort through the individual producer gas dampers. There are ten vertical combustion chambers to each retort—five to each side—and combustion takes place in a downward direction in two stages; this being done by splitting up the secondary air supply to each chamber. The first supply of secondary air is admitted at the same level as the producer gas—viz., 3 ft. 6 in. from the top of the brickwork. The remainder of the secondary air is then admitted to the chamber a further 5 ft. 6 in. below. If all the air necessary for combustion were admitted at one stage the flame produced would be very hot, but too short to reach the bottom of the combustion chamber. The two supplies of secondary air can be adjusted by placing soap bricks over the ports in the top secondary air flues, enabling top and bottom temperatures to be separately controlled. Each combustion chamber has a control damper at its base. The waste gases from the ten chambers then join into one stream and pass over the individual main damper and through the regenerator into the common waste gas flue.

Drying of the Setting.

Main producer gas dampers, individual producer gas dampers, combustion chamber dampers, and the chimney damper are fully opened, and all waste-heat boiler dampers shut. The individual secondary air slides are opened ½ in., and producer charging lids taken off. The lower supply of secondary air to each combustion chamber is shut off, to ensure that the secondary air will be available at the top of the chamber to allow combustion to take place there in the initial "light-up." An old secondary air box is bricked into the hole left just above the producer door for the admission of secondary air to the producer during the semi-gaseous firing period.

Thermometers are placed in positions likely to give typical information—some at the top and some at the bottom of the combustion chambers. If special flue thermometers cannot be obtained, ordinary thermometers reading up to about 500° C. will do if they are fixed with asbestos plugs into the ends of 6 ft. lengths of ¾ in. pipe, the fronts of which have been cut away to expose the thermometer scales. If recording thermometers can be obtained, they are much better; and one instrument placed in an average position is almost a necessity in order to give a continuous record of the temperatures between spot readings, and to show the effect and time lag of the adjustments to the control dampers.

At least five weeks before gas-making is to be commenced the two bottom step plates are put into each grate, a temporary bearer bar is placed across just inside the door, and the space between bridged over with old flat or angle bars on which a small fire is started. These fires should always be kept burning brightly, yet they must not be too big or vigorous, and for the first fortnight about four bucketfuls of fire on each side of each producer are plenty. Breeze fuel is to be preferred, as it will burn more quietly than coke, and can be kept bright if alternate fires are fed every two hours. The producer clinkering doors are just closed, the primary air slides opened full, and the producer secondary air slides left 3 in. open.

After four or five days the producer will be sufficiently dry, and the producer lids are put on. If the fuel being used is wet, a plate with a 3-in. diameter hole in it should be employed instead of the ordinary lid. This will allow any steam driven off to escape instead of going forward with the hot gases. The sight holes in the side producer gas flues are opened for two days. Then they are shut, and those on the top of the combustion chambers opened for about six days. These are then shut, and those at the bottom of the combustion chambers opened for two days. These sight holes are opened in turn, before any pull is obtained in the setting, to allow the gases to escape carrying with them most of the steam, which is driven off from the setting instead of being pulled forward into the other flues. Should pull be obtained in the setting before it is dry, the individual main dampers should be checked to restore pressure conditions.

These times given are not to be taken as definite, but will depend on the initial dampness of the bricks used, the quantity and water content of the jointing used, the weather, local conditions, and the condition of the fires; but steam should not be sent forward if it can be avoided, the presence of steam issuing with the gases at the various sight holes being tested for in the usual way with a piece of mirror. Most of the steam from the inside face of the retort having escaped up the retort, the top mouthpiece and pipe covers are put on, and all rodding hole plugs, except one, inserted. All sight holes can then be shut, and the hot gases allowed to pass away to the chimney. The fires are now fed with coke, gradually increased in size, and the dampers adjusted to give a steady and even rise in temperature throughout the setting. After about the seventeenth day, the bottom six step plates are placed in the producers, the temporary bars removed, and the

usual water drip pipe is extended to allow a small trickle of water on to the plates, to keep the ironwork cool.

In order to keep up to (say) a five weeks' timetable, it is necessary to obtain a daily increase in temperature of 15° C. at a point in the gas stream beyond the silica, as indicated by the thermometers at the base of the combustion chambers. To maintain this temperature rise, it will now be found necessary to increase the depth of the fire by one plate a day, feeding in the fuel from the front, keeping the fire well back, and cleaning every two hours. The usual growth of the chimney pull is about 1/10 in. water gauge in ten days.

At the end of three weeks, by which time the water troughs and all the step plates, except the top one, should be in each producer, some engineers commence feeding the fires through the charging holes; but this is not recommended. The man feeding cannot see the fuel bed, and without very careful supervision sufficient coke may be added to seal the front of the grate, thereby causing an increased quantity of producer gas to be made which is burnt in the producers, giving an excessive temperature in the crown and big variations in the temperature of the actual setting. If the top step plate is left out, the fuel can still be fed in from the front with a shovel, ensuring that the front of the grate is kept unsealed. The fuel should be pushed well to the back of the grate, but kept below the springing of the curtain arch.

The individual secondary air slides are reduced to ¼ in., the clinkering doors shut tightly, the primary air slides opened full, and the producer secondary air slides checked to about a 2-in. opening, which will be found to admit more than sufficient air along with that drawn in over the fuel bed for the complete combustion of all the producer gas. It will be found that after a time there will be a pause in the temperature rise of the setting, which is due to this excess of air being admitted to the producers. Therefore, the primary air and the producer secondary air slides are then gradually checked until only just sufficient air is being admitted for complete combustion of the producer gas being made. The aim is to get a long flame condition, so that the heat is carried along the flues to the nostrils of the combustion chambers, because a short flame condition will only cause excessive temperatures in the producer. The air regulation is gauged to keep the colour of the producer crown not more than dull red.

From this stage onward with a minimum chimney pull of 3/tenths in. water gauge there should be pull at all parts of the setting, to avoid risk of accumulation of unburnt gases, with the probability of explosions at a later date. These pull conditions must be frequently confirmed, individual main dampers being opened where necessary with consequent individual producer gas damper reductions to maintain even temperatures. It will be found that the individual producer gas dampers will have to be graduated so that they are most open farthest from the producers and least open nearest to the producers, while the individual main dampers are most open farthest from the stack and least open nearest the chimney.

About twenty-eight days after firing—*i.e.*, about nine days before gas-making is to be commenced—the producer gas flues and dampers should be showing a dull red. The thermometers at the top of the combustion chambers should be reading about 500° C., and those at the bottom about 300° C., which indicates that all the silica is between 350° and 500° C., and therefore beyond its most critical temperature, so that steps can now be taken to change over to gaseous firing. The thermometers are now removed and the secondary air slides increased to 1½ in.

Lighting Up.

This is the most anxious time in the firing of the setting, and is essentially a job for the daylight, for once it is started the setting cannot be left for even a short time until every combustion chamber is safely lit up and all dampers readjusted. Therefore the fuel bed is further raised overnight so that by about 6 a.m. the fronts of the grates are sealed, and the top step plates put in and well ashed up ready for feeding the fires from the fuel hoppers through the proper charging holes. The sight holes in the side producer gas flues on the tops of the individual producer gas dampers, and also those on top of the combustion chambers nearest the producer gas flues, are opened to allow sufficient air to be drawn in to burn any producer gas coming forward. The primary air producer, secondary air slides, and the individual producer gas dampers are adjusted so that about the same amount of producer gas is burning on each damper, yet none is going forward unburnt. The producers are now fed every half hour with small quantities of coke, which is evenly distributed over the fuel bed, but kept clear of the secondary air port. This can be done by the supervisor viewing the fires through the ports and giving instructions to the man doing the feeding; any coke falling near the ports being pushed to the back with a rake. After each addition of fuel, each individual producer gas damper is immediately inspected to see whether the gas is still burning or has been extinguished due to:

(1) Loss of pressure in the producer gas flue due to the escape of the gas through the charging lid.
(2) Dilution of producer gas with air admitted to the producers along with the fuel.
(3) Addition of too much fuel at a time, causing blacking out of the fire and cooling of the producer gas flues.

If the producer gas is not burning at any damper, it must be immediately lighted with paper; care being taken to keep clear of the flash.

By 10 a.m. the individual producer gas dampers should be a bright red, and the nostrils of the combustion chambers a dull red. This is sufficient to ensure that the gas can be kept burning if it is allowed to go forward, so the producer secondary air slide is shut and the amount of coke added every half-hour increased until this slide is covered. If there is any tendency for the gas to be extinguished at feeding times on more than the end two dampers farthest from the producers, or any difficulty in lighting these up again, the primary air slides must be closed, the fires ashed out until the producer secondary air slides are unsealed, and the slides opened again. The setting should be allowed to become warmer before attempting to restart gaseous firing.

The flames should now reach the nostrils of the combustion chambers of each retort nearest the producer gas flues, so that the sight holes at the individual producer gas dampers can be shut. Increasing quantities of fuel are added every half-hour, and the producers should be full by 2 p.m., by which time the combustion chamber nostrils nearest the producer gas flues will be bright red, and the sight holes above them can be shut, and those on the top of the combustion chambers farthest away from the producer gas flue opened, thereby allowing some gas to get across and be burnt at the other nostrils. By 4 p.m. conditions such as make of producer gas, pull, and temperatures will be settling down, and all the sight holes can be shut and all dampers checked back to an absolute minimum, so that the gas is just kept burning. Individual producer gas damper openings of ¾ in. nearest the producers, up to 2½ in. farthest from the producers, and the same for the main dampers in the reverse direction, with 1 in. of secondary air and about 1 in. of primary air, with a chimney pull of 4/10ths, will usually ensure that after twenty-four hours only a very slight dull colour is visible on the inside face of the retort walls. At this stage it is an advantage to have a slight excess of producer gas, so that a little can be seen burning at the bottom of the combustion chambers, as this will prevent local heating at the top of the retort due to a short sharp flame, and will also warm up the regenerators.

The fires are now fed every four hours and cleaned every eight hours, but until the retorts are coked up it may be found in some cases that sixteen or twenty-four hour periods between cleaning is sufficient.

If the working temperature of the setting is to be 1400° C., it is advisable not to attain this temperature at once, but to work the first three months at a maximum of 1350° C. and then increase to 1400° C. A dull red colour being taken as 700° C., a temperature rise of 650° C. is to be obtained in eight days, which allows a rise of 80° C. a day; and as near as possible the top temperatures should be raised at this rate. The bottom temperatures will not increase in due proportion, but will lag somewhat until the top temperatures have risen sufficiently to allow all the gas to burn in the chambers, instead of some escaping and burning beyond. Three or four days after lighting up, when most of the expansion of the top portion of the retorts is complete, all cracks on top of the setting are pointed-up, and any expansion cavities which have not taken completely up caulked with asbestos rope before pointing, to prevent ingress of dust and grouting. The side walls are then pointed. To stop any leakage between the secondary air and producer gas flues via the common expansion cavity between the setting and the flue walls, the insides of the gas and air flues are pointed at the position where this cavity intersects them. One day before gas-making, the collar joints on the offtake pipes of the retorts are made, the retorts and castings filled with small coke, the top mouthpiece cover is put on, and the joint is made. To compensate for the cooling effect of the cold coke on the retorts, the primary air and openings of all dampers are previously increased so that the temperatures will rise sufficiently to allow them to begin gas-making twenty-four hours later.

Two or three days after starting up, the temperatures of the combustion chambers are levelled up by adjusting the check tiles on the bottom of each chamber. After the first three months' working, when the top temperatures are raised, resulting in higher throughputs which will call for heavier steaming, some difficulty will be met in obtaining sufficiently high bottom temperatures for complete steam cracking without two-stage heating. The bottom secondary air supplies are therefore opened and adjusted to give a longer flame condition.

Experience of the plant itself will eventually indicate the adjustments necessary to maintain correct working temperatures; but, generally, if the bottom heats are low, more producer gas is needed, and if the lack is general over a section, more primary air is needed. If, however, an individual bottom heat is low, that individual producer gas damper needs increasing. If the bottom heats are too low while the top heats are too high, the secondary air needs reducing; while if the top heats are low and the bottoms good or too high, the secondary air needs increasing.

Reduction of Heats at Scurfing Time.

At scurfing times the individual producer gas and main dampers of the retorts to be scurfed are reduced sufficiently to cause the top temperatures to fall to about 1100° C. and the

bottom temperature to about 850° C. Some adjustment to the chimney pull and primary air may be necessary at the same time to maintain normal conditions in the other retorts. The adjustments are reversed when the retorts are put back to work.

Shutting-Down of a Whole Range for a Day.

For a shut-down period of twenty-four hours, the heats are lowered by gradually reducing the primary air and the chimney pull four hours before the coke extractors are stopped. Any subsequent adjustment necessary to individual retorts is carried out by the alteration of individual producer gas and main dampers. The fires are fed regularly, but not cleaned until the shift prior to starting up. Four hours before the extractors are started, normal conditions are gradually resumed.

Shutting-Down of Individual Retorts for Repairs.

Though the practice is not to be commended, in case of necessity individual retorts can be shut down and cooled sufficiently for bricklayers to get into them and repair sections of the retort walls in about a week after shutting down.

The retort is scurfed in the usual way, and the top mouthpiece cover is left off. The bottom door of the retort is opened slightly, and then the individual producer gas and main dampers further checked to cause the temperature to fall gradually, so that in five days there is no colour left on the inside face of the retort. The offtake pipe collar joint is then broken to prevent distortion or fracture of the ironwork, the bottom door opened full, the producer gas and main dampers are shut and sealed up with fireclay, the secondary air slides fully opened, and the producer gas damper box covers taken off. All colour has usually disappeared from the combustion chambers in another day's time, and then all the sight holes on top of the chambers are opened, and the cleaning box covers at the bottom of the chambers removed. A draught is thus obtained all round on both sides of the retort walls; and if the sight hole boxes on top of the chambers are removed and the bottom manlid is removed from the retort on the next day, the retort will be cool enough to get into on the following day. When the repairs are finished, the retort is lighted in the usual way, and its temperature gradually raised so that it is ready for gas-making in about nine days' time.

Shutting-Down a Whole Range for Repairs.

Four hours before the last coal enters the retort, the primary air and the chimney pull are reduced, and cleaning of the fires is stopped, but feeding of them is continued. When gas-making is finished, the retorts are emptied and scurfed as at the usual scurfing times, and all retort covers and plugs are replaced. Individual adjustments are then made to the dampers to maintain the retorts at scurfing temperature for about a week, and should the supply of producer gas be insufficient during this time the fires must be broken up and the primary air increased. After this time the fires are not cleaned again, and the primary air slides are practically shut. These adjustments, along with the clinkering of the fires and the gradual falling off of the chimney pull, will cause the retorts to lose colour gradually. After the second week the retort offtake collar joints are broken, and the primary air slides and the main producer gas dampers behind the producer curtain wall are shut. The top mouthpiece covers are removed and the bottom doors unsealed, so that the retorts gradually cool down, and by the end of the third week will be cool enough to commence dismantling. The producers must be fed regularly to prevent a free space forming in them in which gas may accumulate and explode at a later date. The regular addition of cold fuel also helps to cool the producer; and if the clinkering doors and primary air slides are tight, practically no fire will be left at the end of three weeks, when the doors can be opened, the clinker broken up, and the producer emptied, the unburnt fuel going to boilers.

Starting Up Half a Range.

If half a range of retorts is needed to be fired before the construction or repair of the other half is complete, temporary 4½-in. walls should be built in the main waste gas flues on the chimney side of the unfinished half, and in such a position that access can be obtained to them. The drying and firing procedure will be the same as described for both halves, except that, before the temporary blanking-off walls are removed, the individual retort dampers in the second half will have to be nearly shut in order to get the correct conditions for steady firing.

Discussion.

The President said they were indebted to Mr. Bengough for a very informative paper, and one which dealt with the subject of continuous vertical retorts from a different angle from other contributors this session.

Mr. A. R. Myhill, in proposing a vote of thanks to Mr. Bengough, said the session now concluded might be almost called a "vertical retort" session, owing to the number of papers that had been presented dealing directly or indirectly with the subject. He regarded Mr. Bengough's contribution as almost unique, because he did not think there was any published information on the subject given with the detail that had characterized that paper. Mr. Bengough had given them some most valuable information on the subject of the lighting-up of the retorts, and of the importance of obtaining the necessary temperature by a gradual process. Mr. Myhill referred to the temporary shutting-down of retorts by reason of occasional holidays, and suggested that it might be well for the life of the retort if a more or less equable temperature could be maintained even in such circumstances as those.

Mr. W. Macnaughton (Wolverhampton), in seconding the resolution, stated that the contribution was one of considerable value to the gas engineer.

Mr. E. B. Tomlinson (Nechells Gas-Works), who was cordially welcomed by the President, stated that at those works they worked the vertical retorts very slowly in their early stages. There were some who thought they worked them too cautiously; but he considered that those who had to do with the handling of settings would not share that opinion. In the early stages, for the first twelve or eighteen months he did not think they exceeded a 6·7 ton throughput, and experience had shown that the care thus taken with regard to the settings had been justified financially. With a little more experience he did not say that they might not have gone a little faster; but within what he called a reasonable time they reached a 7-ton throughput, and at the present time the average was nearly an 8-ton throughput. It was apparent to him that if care was taken to avoid unnecessary and undue extensions and contractions in the early stages the results obtained in the life of the settings justified that policy. The question of the expansion and contraction of silica was one that needed constant watching; and it might be that the subject of the allowances for contraction and extension would have to be reconsidered because of the improvement in the silica supplied by the leading makers That improvement applied to grinding, grade mixing, and burning; and the after-expansion figure was continually coming down.

The vote of thanks was passed, and the author answered a number of questions.

SCOTTISH JUNIOR GAS ASSOCIATION (EASTERN DISTRICT).

Visit to Galashiels Gas-Works.

About 30 members of the Scottish Junior Gas Association (Eastern District) travelled to Galashiels on Saturday, April 13, where they were entertained by the Galashiels Gas Light Company. Mr. Alex. Dow, the Engineer and Manager, received the party, and conducted them over the plant.

Mr. Dow remarked that the works were first built by Messrs. Donald & Wilson, of Paisley, in 1864. Originally (95 years ago) the manufacturing station was in the centre of the town, but 30 years later was transferred to the present site. In 1920 a scheme of reconstruction had been commenced; and the visitors would see what had been done since then.

There remains in a section of the retort house a bench of horizontals erected in 1901 by Robert Dempster & Sons, Ltd., of Elland. The retorts are 10 ft. 6 in. long, placed back to back, and the bench is provided with a Scott movable platform travelling over an open sunk chamber. This bench is not now in use.

In January, 1920, one of the old horizontal benches was demolished and a bench of 8 Dempster-Toogood vertical retorts, having a capacity of ½ million c.ft. per day, was installed. Despite the fact that this work was done during the period of the trade boom, the bench was erected and put into commission by Nov. 21 of the same year.

Mr. Dow explained the construction of the setting by means of a coloured diagram and a blue print showing sections through the retorts and heating flues; an elevation of the furnace side, and the chimney side; damper control; and details of the hydraulic mains.

The extractor mechanism was explained in detail. This is driven by vertical gas engines laid down in duplicate. The producers are of the step-grate type provided with four streams of water, the fuel sitting in water to a depth of about 6 in.

The party travelled to the top of the beds and on to the coal and coke hoppers, from which by means of suitable chutes the coal or coke is fed into the retorts or furnaces.

In an up-to-date power house a 40-h.p. Bates gas engine is employed for the generation of electricity, which is used to drive the hoist, elevator, and coal breaker. A switchboard arrangement provides for alternative town's supply in event of a breakdown.

The "Permutit" water softening plant received the visitors' attention. Mr. Dow explained the principles, and said that this was installed at a cost of £160 and had paid for itself in the first year by increased efficiency of the boilers.

Having travelled over the entire plant, the visitors were then conducted to the Douglas Hotel, where they were entertained at tea by the Company.

Bailie J. C. Dorward, a Director of the Company, in the absence, through illness, of the Chairman, welcomed the Juniors to Galashiels,

and expressed the hope that what had been seen had proved of interest.

Mr. R. J. Gavin (President), replying, said that the visitors were indebted to Mr. Dow for the way in which he had shown them round.

Mr. Dow said he was grateful for the kind words expressed by Mr. Gavin. It would be a pleasure to convey to the rest of his Board their appreciation of what had been seen at the works and for the hospitality extended. He was himself proud of the accomplishments at Galashiels in respect of the reconstruction. The first stage, commenced in 1920, was the largest, and was carried out during a most trying period when the problem of securing material and labour was a difficult one. Indeed, the firm carrying out the work had to obtain on loan a number of brick-setters from the Corporation of Leeds. While the demolition of the old bench and the erection of the new verticals were going on, no interference of the continuity of supply from the horizontals took place. The expenditure had been great, involving £52,000. That figure had, however, been entirely cleared off last year.

RECORDING GAS CALORIMETRY.

By W. Masterton, B.Sc.Tech., of Edinburgh.

Since the Gas Regulation Act came into force this subject has been of increasing interest. Previous to 1920 there were recording and indicating calorimeters of sufficient accuracy for works control, but since the passing of the Act there has been a demand for a recorder which will answer to more exacting requirements. Under statutory conditions, recording calorimeters are being used to ensure that the quarterly average calorific value does not fall short of the declared calorific value, and also to ensure that on no occasion does the calorific value fall below the permissible minimum for a period exceeding two hours. For statutory purposes, a higher standard of accuracy and reliability is required than is the case for works control purposes. The several inventors have been perfecting their instruments for the past decade, and it is only now that the Gas Referees are widely adopting them for official purposes.

Recording calorimeters are used for the double purpose of obtaining constancy of calorific value and a record of the thermal output. They could also be profitably used for measuring the performance of experimental plant, whether the tests are being run to determine the value of gas-making coals or to determine the best conditions of carbonization.

The first step in the development of gas calorimetry was made by F. W. Hartley in 1882, when he invented the first water-flow calorimeter. The next stage was reached when Junker fitted his own water-flow calorimeter with additional devices which enabled a record of calorific value to be made automatically. Another distinct stage was marked by the appearance of the Beasley recorder, which is of an entirely different class from the Junker. Junker's recorder measured the quantities involved; Beasley's does not measure the quantities directly. The pointer merely moves in one direction for increasing calorific value, and in the opposite direction for decreasing calorific value. The Beasley must therefore be calibrated from the results of a water-flow calorimeter. The Junker and Beasley typify the two classes of recorder—the scientific and the inferential. These classes have developed contemporaneously—each class has its own uses, but the Junker itself it not now extant.

The next outstanding step was taken by Simmance when he produced recorders which automatically correct for the conditions of pressure and temperature of the gas. The Junker recorder did not give the corrected value. The past decade has produced and developed the Fairweather, the Thomas, and the Boys recorders, which are of the scientific class, and each of which the Gas Referees are prepared to certify for official work.

The author then described in detail the various types of recording calorimeter, giving the theory of each.

Mr. Gavin expressed his appreciation of the address.

Mr. Dow said he had listened very attentively to the highly technical paper. There could be no doubt in the minds of gas engineers that they required the very best and most accurate instruments for recording calorific values.

NOTES ON COAL.

By F. B. Waller, of Alloa.

It is a simple matter to erect a small horizontal retort heated by gas, together with condensers, purifier, meter, and small holder having a capacity of about 12 c.ft. In such an apparatus, 1½ lbs. of coal may be conveniently distilled. A test of this nature enables one to ascertain the yield of gas, tar, ammoniacal liquor, and coke per ton of coal, together with the analysis and calorific value of the gas, giving the yield of therms per ton of coal, strength of liquor, and quality of tar. A coal which gives satisfactory results from such a test can be tried with every confidence by the gas manager.

Too much stress cannot be laid on the importance of testing supplies of coal regularly and frequently. The quality of coal supplied to the various undertakings is always varying, the principal factors being the ash and the size of nuts supplied. The size of the nuts regulates to a large extent the quality of the coke produced, in so far as the quantity of saleable coke and breeze made is concerned.

Smaller nuts result generally in a large yield of breeze. The following sizes of screens may be taken as representing the average used at the collieries:

Gum	passing through	¼ in.	
Pearls	,,	½ in.,	but over ¼ in.
Singles	,,	1 in. ,,	,, ½ in.
Doubles	,,	1¾ in. ,,	,, 1 in.
Trebles	,,	3 in. ,,	,, 1¾ in.
Jumbos	,,	4 in. ,,	,, 3 in.

The results of tests obtained from a large number of gas undertakings show that the size of nuts has not been maintained. In many cases over 50 p.ct. of the nuts supplied as doubles conform to the standard sizes for singles, pearls, and duff.

Steaming.

One of the most important considerations in connection with steaming is that of the coke yield. From the Gas Investigation Committee's results, it would appear that for each additional 6570 c.ft. of gas made beyond the yield of straight gas, 1 cwt. of coke is consumed. An idea of the amount of steam in lbs. required by one ton of coal yielding approximately 18,000 c.ft., made up of 1200 c.ft. straight gas and 6000 c.ft. of water gas, can be calculated in the following manner:

Carbon *plus* H_2O = CO *plus* H_2
18 grammes = 28 grammes *plus* 2 grammes
= 44·66 litres

44·66 litres require 18 grammes of steam
1·57 c.ft. require 18 grammes of steam
6000 c.ft. require 68,790 grammes of steam
= 152 lbs.

Theoretically: 1 ton of coal requires 152 lbs. of steam.
Practically: Allow (say) 50 p.ct. = 225 lbs. of steam.

This figure conforms closely to the amount of steam registered by meter.

Coal Storage.

It is customary, and it has been found advantageous, as the experience of the coal strike of 1926 showed, to provide ample coal supply and storage. Coal should preferably be stored under cover, but where large supplies may have to be called upon, as in 1926, this is seldom possible. The chief disadvantages of storing coal are possibility of spontaneous combustion, which danger can be lessened by keeping the stocks to within a depth of 10 to 15 ft.; loss in quality due to weathering; and cost and effect of handling. Constant exposure to the weather causes coal not only to deteriorate in quality, but to lose in quantity.

The following is a note of the calculation of the thermal efficiency of the vertical retort installation at Alloa:

Heat Balance of Vertical Retort Installation at Alloa Gas-Works.

Total Heat Units in Raw Coal.

			Therms.
7,467·6 tons	= 16,727,424 lbs. at	14,734 B.Th.U. per lb.	= 2,464,177
4,978·4 ,,	= 11,151,616 ,, ,,	13,594 ,, ,, ,,	= 1,515,950
12,446·0	27,879,040	Total	3,980,127

Heat Units in Products.

	Therms.	P.Ct.
Coke saleable = 5256·36 tons at 12,000 B.Th.U. per lb.	= 1,412,907	= 35·49
To producers at 75 p.ct. efficiency = 1100·025 tons at 12,000	= 295,687	= 7·43
Fuel to boiler at 60 p.ct. efficiency = 1146 tons at 11,520 B.Th.U.	= 308,045	= 7·74
Tar = 212,546 galls. at 14,000 B.Th.U. per lb. .	= 315,418	= 7·92
Gas = 198,096,600 c.ft. at 420 B.Th.U. per c.ft.	= 832,006	= 20·90
Total	3,164,063	= 79·48

Discussion.

Mr. Gavin remarked that, in regard to the storage of coal, he thought that since most works were getting an increased quantity per ton from verticals and/or through steaming, it was not quite so necessary to have such large stocks as heretofore.

Mr. Dow recommended that where coal was laid in for stock it should not be dropped from an elevated position, as there was the likelihood of compressing it and making it into a powder. He had made a practice of clearing-out stocks from time to time—annually if possible. He was hopeful that Mr. Waller's remarks regarding the size in coal supplies would get to the ears of the colliery owners. The experiences in the Lothians were similar to those mentioned. He considered it difficult for a small works to possess a laboratory in which the many tests could be carried out. On the other hand, if some of the large works, such as Edinburgh, which had splendidly equipped laboratories, could issue in brochure form a tabulation of the results obtained from tests, a considerable amount of benefit would result to the small works.

Mr. A. L. Duff (Edinburgh) mentioned what was done at Granton to prove that the specifications of supplies were in order.

Mr. J. R. Moyes (Stirling) considered that, while one might obtain a certain yield from 1½ lbs. of picked coal, the proportionate expectations from bulk supplies often fell short.

Mr. Waller, replying to the points raised, considered that it was the general experience all over Scotland to find that coal supplies were below the specified standards of size. He emphasized that in Alloa, when sample coal was chosen for test, the 1½ lbs. was picked at random. If stones, &c., were present, these were picked in proportion.

Mr. Dow and Bailie Dorward repeated their expression of pleasure at having the members of the Junior Association present with them that day; and the meeting then closed.

SCOTTISH JUNIOR GAS ASSOCIATION (WESTERN DISTRICT).

Closing Meeting of the Session.

The Closing Meeting of the Twenty-Fifth Session of the Association was held in Glasgow on April 6—Mr. JOHN MURRAY, President, in the Chair.

ANNUAL REPORT.

The HON. SECRETARY submitted the Council's Annual Report, which stated that the total membership is now 327—an increase of 15. While the membership shows an increase, the Council regret to report that the attendance at ordinary meetings has not shown any increase. The Annual Conference of the British Juniors was held at Bristol. The Association was represented, and a new constitution was drafted. This will in due course be submitted to the various Associations for approval. A special appeal is made to the Scottish Eastern to affiliate, and so bring all the Junior Associations into the movement. The attention of the members is drawn to the fact that the Association has two representatives on the Scottish Education Committee. Any member requiring advice, it is stated, should approach Mr. Hall or Mr. Murray, who are prepared to assist in every way. The Council feel that the provisions they recommend, and which are provided for by the Institution, have not been fully explored, and they are confident that to make the Institution an examining body only would be a retrograde step. The Council place on record their appreciation of the work done by Mr. T. F. Carswell during his time of office as Secretary and Treasurer.

Office-bearers for next session were elected as follows:
President.—Mr. R. D. Keiller, Greenock.
Vice-President.—Mr. D. Melvin, Uddingston.
Hon. Secretary and Treasurer.—Mr. A. Bujnowski, Glasgow.
Council.—Messrs. J. Greig, Dawsholm; T. Gray, B.Sc., Provan; A. R. Anderson, Alexandria; R. Eadie, Provan; W. Kirk, Polmont; and A. Macfarlane, Dalmarnock.
Auditors.—Messrs. C. Gill and S. MacGowan, Glasgow.

ADDRESS

By C. S. SHAPLEY, Engineer and General Manager of the Leeds Gas Department.

By the grant of the Royal Charter the Institution will become a State constituted association, as distinguished from a private company. Thus it will be given the status and official position to which its influence and good work entitle it. The members will have the privilege of calling themselves Chartered Gas Engineers, and thus showing the people with whom they have dealings that their qualifications have been tested, and that they have received recognition as men of outstanding merit in the profession. While there will thus be added status to the members, the discrimination between those so qualified and those who are outside their ranks will be definitely established.

The distinction of being a Chartered Gas Engineer carries with it the obligation to see that no one enters the Institution whose education and training are not up to the high standard established. Nothing but good can come from making the standard high, and maintaining it so.

With the added value of being a member of a Chartered Institution comes the increased responsibility of doing work worthy of the traditions of all the organizations that possess a Royal Charter; and in the future the value of the title Chartered Gas Engineer will depend entirely upon the exertions of the individual members. Thus the title to admission to membership must be jealously guarded.

EDUCATION.

In common with other Junior Associations, the Scottish Junior Gas Association (Western District) are to be congratulated on the enthusiastic interest they have taken in the Education Scheme. Many of the modifications in the Scheme are the outcome of the carefully considered memorandum which they submitted to the original Education Advisory Committee, on the occasion of the Committee's conference with the representatives of Junior Gas Associations in March, 1927.

Though the Scheme has been considerably modified, the official "Green Book" is still so full of regulations and conditions that it is beyond the comprehension of many would-be students. One may go further, and say that there are few engineers who sufficiently understand the complications of the Scheme to be able to give definite advice to their juniors.

Such an unfortunate state of affairs has certainly been against the success of the Scheme; and had it not been for the formation of District Committees, many students would have found great difficulty in ascertaining the course of study they should pursue. The District Committees, who are acquainted with local conditions and the facilities available where instruction can be obtained in the ancillary subjects, as well as in gas engineering and gas supply, are able to advise students, or potential students, of the course they should follow. The Yorkshire District Education Committee wisely decided that their first step was to ascertain the facilities available for tuition, and also what demand there was from students and potential students. Armed with this information, the Committee have been able to give definite advice to all inquiring candidates; and with the co-operation of the English Board of Education, seven new classes at suitable centres have been formed this session.

Despite all the successful results which have been achieved, it is realized there still are numerous difficulties. Probably the alterations and modifications to the Scheme at present in progress will remove many of these.

From time to time suggestions are made that the Institution of Gas Enginers should conduct their own examinations, as is done by the Institution of Mechanical Engineers; but here let it be pointed out that this would be a complete departure from the fundamental principle of our Scheme, which is an Education Scheme, not simply an Examination Scheme. The District Education Committee have considered applications from a number of candidates to sit for the examinations, and in many instances the lamentable way in which the letter or application has been couched, coupled with the low standard of educational successes submitted, makes one feel that an intensive form of an Education Scheme is very desirable. Naturally, the wider the scope of one's education, the better the qualification for the final honours; but the regulation is not a hard or fast one, and, when applied, it is frequently in cases where higher educational attainments prevail.

The Education Scheme has much elasticity, and the Committee practically unlimited discretionary powers. The would-be candidates may have an easy or a very troublesome passage—indefiniteness seldom meets with approval. In the Education Scheme there is so much that is indefinite that it becomes a common saying, "Each case is treated on its own merits." This has advantages, as well as disadvantages, to the student.

If an examination scheme were to be adopted, it would be readily possible to define clearly the subjects in which the student would be examined. Where he obtained his tuition would not be specified—the examination would be the test of knowledge gained. For a time there would be a considerable number of failures, due to students sitting examinations before being qualified, and for whom an Educational Scheme is most desirable.

At the Conference in March, 1927, previously referred to, the English Junior Associations submitted a memorandum, suggesting that the Institution of Gas Engineers should hold their own examinations in ancillary as well as the main subjects, as is done by other Institutions. The Scottish Junior Gas Association (Western District) submitted a more modified memorandum, which did not break away from the fundamental principle of the Scheme—*i.e.*, education, not examination—and consequently it was gladly received by the Advisory Committee.

No one can gainsay the advantage to be gained by the attendance at a class, with personal touch with the teacher. This is clearly instanced by the advantages accruing from the private classes which large undertakings hold in their own works. As smaller undertakings cannot hold such classes, and the student is often some distance from a technical school at which there is "an approved course," we immediately begin to come up against the difficulties of complying with the numerous regulations of the "Green Book."

The Scheme may have disadvantages, but I have not yet met any unsurmountable difficulties, and I do not feel prepared, at present, to support any recommendation for the substitution of an examination scheme.

The Board of Education have co-operated most loyally—in fact, one wonders how they find it possible to devote so much time to the working of the Scheme. The Yorkshire District Education Committee could not possibly have been successful in providing classes at seven new centres had it not been for the assistance so readily given by the Board of Education. Should we find isolated students not yet provided for, there does not appear to be any reason why our co-operation with the Board will be less satisfactory.

I can assure you any suggestions as regards any improvement in the Scheme will be most carefully considered by the Council of the Institution of Gas Engineers through the Education Committee.

TACT.

Tact, according to the dictionary, is "adroitness in managing the feelings of persons dealt with," which I interpret to mean a careful choice of words combined with restraint of action. This is quite as essential as attention to duties, and is absolutely necessary if you are to move to higher positions. Tact in the control of our less fortunate brothers—the employees—is essential; and here is a very vital point I wish to bring home—the influence of the Juniors on the industry and on employers. Juniors come in direct contact with the

men. Remember that the employees are human beings with souls and minds, and that a few have a fair share of brains. Treat them as human beings, not as machines. Greet them with a kindly word, a smile, and deal with them with great tolerance, bearing in mind that "life without sentiment is like a picture without light." Endeavour to put yourself in their place. Lead them; do not drive them. Lead by persuasion, force of character, and good precepts.

Vote of Thanks.

The President expressed the thanks and appreciation of all present to Mr. Shapley for his inspiring address. They had expected some sound advice from such a noted speaker, and they had not been disappointed. With regard to Mr. Shapley's remarks on the Education Scheme, the Western Juniors still held to the views expressed by their delegates in the 1927 Conference—that it would be a retrograde step for the Institution of Gas Engineers to be only an examining body.

Mr. D. Melvin (Uddingston) thanked the Association for the honour conferred on him with the appointment of Vice-President, and assured them of his best services. He was pleased to know that the memorandum prepared by the Western Juniors of Scotland had been so effective. He felt that the care of isolated students was more common in England than in Scotland. He appreciated Mr. Shapley's remarks regarding the attitude towards men.

Mr. J. W. McLusky (Glasgow), in thanking Mr. Shapley, spoke of him as "a young man's man." Tact was a big factor in handling men. They must remember that every man had a personality and a soul. The soul might not be manifest or the personality brilliant, but these must at all costs be protected. Condemn the job if they would, but preserve the man's soul and personality. Mr. Shapley's address had done much to stimulate the Juniors to action and progress.

Mr. Shapley, in reply, thanked the members for his reception and for the appreciation of his address.

The members then adjourned for tea, which was followed by whist, music, and dancing.

During the evening the prizes for papers, presented by Mr. Nisbet, of Paisley, were awarded to:

1st, Mr. Wm. Scott, of Glasgow, for his paper on the "Control of Calorific Value."

2nd, Mr. A. McDonald, B.Sc., of Motherwell, for his paper on the "Unification of Gas Undertakings."

Mr. R. Fife (Kilmarnock) presented the President's medal to Mr. Murray. He referred to Mr. Murray's work over a period of seven years, as Secretary, Vice-President, and President, and he assured him of the appreciation and good wishes of every member.

Mr. Murray said it had been a very happy service. He thanked the members for their support during his year of office, and called for renewed effort to ensure the continued success of the Association.

WASTE HEAT RECOVERY.

By Major W. Gregson, B.Sc. (Eng.), Assoc.M.Inst.C.E., A M I Mech.E

Extract of a Paper before the Institute of Fuel on April 10.

The modern coke oven, fired by a portion of its own live gas, has now been developed along highly regenerative lines, and waste-heat boilers are only applicable to the older designs of non-regenerative ovens. In this latter connection it is possible, with properly designed boilers, to recover some 1-1·4 lbs. of steam per lb. of coal carbonized. It is of interest to note that the application of effective waste-heat boiler plant to older batteries of non-regenerative ovens, where the latter are fitted with bye-product plant, has in a number of instances been sufficient to enable the working of the ovens to be carried out on commercially sound lines, and so avoid the scrapping of plant otherwise in good structural and mechanical condition.

In gas-works—*i.e.*, retort—practice, the universal fuel is producer gas, and the application of waste-heat boilers, both to regenerative and non-regenerative settings, is nowadays standard British practice.

Waste-heat boilers in a gas-works cut down, and in many cases entirely eliminate, fuel-fired boilers running on coke/coke breeze; and it is therefore necessary to have a ready market for the latter for the full advantages of waste-heat boilers to be realized. Fortunately, the use of coke/coke breeze as a smokeless fuel for general industrial work, its use as a producer fuel, and a market in connection with breeze blocks for building, have all developed in recent years; furthermore, the general steam demand in gas-works has increased with modern plant—first for process work and secondly for power services to replace operations originally performed by manual labour.

Retort practice falls into two main sub-divisions, verticals and horizontals; and the main difference from a heat-balance point of view is the sensible heat in the discharged coke, this representing as much as 25 p.ct. of the total heat to settings in horizontal practice.

On vertical retorts "steaming" is almost universally practised, enabling the retorts to give a high yield of gas of standard calorific value with any class of coal, and the coke is cooled by this incoming steam in addition to the secondary air circulation mentioned earlier in this paper. Unless, therefore, the sensible heat is extracted from the hot coke after it has been discharged from horizontals, the horizontal setting cannot be as efficient from a heat-balance point of view as a vertical installation.

Full recovery of waste heat is effected from the flue gases in modern verticals by steam generation only, as air preheating is effected (*a*) from the coke, and (*b*) by picking up heat otherwise lost by radiation.

In horizontal practice the waste-heat boiler follows the recuperators—*i.e.*, the steam yield is only about half that obtained from verticals. Of course, when the potential steam *ex* dry-quenched hot coke is added to the waste-heat steam yield, the comparison becomes very much closer; but the first cost of such plant is a serious factor except in special cases.

Mention should be made of water gas plants in these notes. A large amount of heat is rejected during the "blow" period, and forms an admirable subject for recovery as steam. At the early stages of the "blow" the waste gases are composed almost entirely of inert constituents and products of combustion; but as the "blow" progresses, free combustibles mix with the effluent gases, and to get full recovery effects it is necessary for the boiler to be fitted with a special inlet box with secondary air jets for burning off these combustibles. In modern practice some 80-100 lbs. of steam can be generated per 1000 c.ft. of water gas—*i.e.*, sufficient to make the plant self-contained. In this latter connection the use of exhaust steam from the turbine-driven blower is a further economy, though difficult to arrange with a single unit, owing to the cyclic operation of the plant, unless, of course, an accumulator is provided. With a battery of water gas plants, these fluctuations are, of course, evened out, and the problem is simplified.

A few typical test figures on waste-heat boilers of the firetube type applied to retort settings by the author are appended, and represent tests carried out under normal working conditions—*i.e.*, no special preparation or "tuning up" in any case.

Typical Test Figures on Fire Tube Waste-Heat Boilers (Spencer-Bonecourt).

—	No. 1.	No. 2.	No. 3.	No. 4.
1. Type of plant	Glover-West Vertical Retorts	Woodall-Duckham Vertical Retorts*	Drakes Horizontal Retorts.†	Gibbons Horizontal Retorts.‡
2. Fuel per hour, lbs.	7,060	1,760	1,075	6,300
3. Temperature of boiler inlet gases, ° C. (T_1)	800	582	460	699
4. Temperature of boiler outlet gases, ° C. (T_2)	230	228	199	222
5. Excess air, p.ct.	112	110	200	40
6. Heating surface of boiler(s) under test, sq. ft.	6,880	2,440	1,850	8,800
7. Steam pressure, lbs. per sq. in.	115	100	100	68
8. Corresponding saturated steam temperature, Ts	347° Fahr. = 175° C.	328° Fahr. = 170° C.	338° Fahr. = 170° C.	314° Fahr. = 157° C.
9. Superheat	95° Fahr.	106° Fahr.	92° Fahr.	*Nil*
10. Feed temperature, ° Fahr.	90	200	134	130
11. Evaporation per hour actual, lbs.	30,000	6,680	2,745	20,000
12. Evaporation factor	1·25	1·11	1·17	1·12
13. Evaporation per hour from and at 212° Fahr., lbs.	37,500	7,420	3,213	22,400
14. Evaporation per hour per lb. of fuel, lbs. from and at 212° Fahr.	5·3	4·21	2·98	3·55
15. Fan H.P. as percentage of total steam	7·8	§	14·5	11·25
16. Extraction efficiency: $= \frac{T_1 - T_2}{T_1 - Ts} \times 100$	91 p.ct.	86 p.ct.	90 p.ct.	88 p.ct.

* Older type with regeneration.
† With extra deep regenerators.
‡ Sub-normal regenerators.
§ Turbine driven fans, the exhaust being returned to the circuit as hot feed.
Fuel on Nos. 1 to 4 (inclusive)—coke, producer fired.

Discussion.

Mr. J. Reber agreed with the author's figures concerning carbonizing practice, and said that with modern carbonizing plants it was possible now to recover 45 to 48 p.ct. of the calorific value of the

fuel in the form of steam; the carbonizing process taking about 25 p.ct. The radiation and stack losses amounted to only 17 p.ct., whereas in former years they amounted to between 50 and 60 p.ct. With regard to recuperators, there was actually a design now in use on the Continent in which the combustion gases were split up into two sections; one-half going to the recuperator, and the other half going direct to the waste-heat boiler. This design had the advantage of giving high-temperature gases, and enabling a smaller boiler to be used for the same output of steam. In gas-works practice the steam requirements varied from 700 lbs. to 1300 lbs. of steam per ton of coal carbonized, and with modern carbonizing plants all the steam required on the works could be produced by waste-heat recovery. In fact, on many plants, there was a surplus. In such plants, especially with the old type of recuperator, where waste-heat recovery did not produce all the steam required, the necessary steam could be generated by mixing producer gas with the waste gases, instead of having an extra direct-fired boiler on the works. A plant of this description had been working successfully for some years at Redditch.

Dr. Barratt said that little had been done by engineers on the subject of loss of heat by radiation. Though the laws of radiation were accurately known, their application to industrial and engineering problems had received little attention. In most heat-balances the item "losses due to radiation, &c.," was lightly dismissed, though it frequently amounted to 5 or 10 p.ct. of the total losses. It was seldom, or never, actually measured; and the method usually adopted of arriving at its value was delightfully simple, consisting merely in subtracting the total losses up to date from 100. As a matter of fact, the losses put down to radiation were frequently due chiefly to convection, unless a high temperature was involved. He had occasion some years ago to measure the proportion of radiation and convection from surfaces kept at about 100° C. in still air, and was rather surprised to find that for a thin wire the proportion of radiation to the total heat lost was only 2 or 3 p.ct.; the rest being convection. For larger cylindrical surfaces the radiation loss increased with the diameter, but even for a flat vertical surface the proportion of radiation was less than 50 p.ct. In a current of air or other fluid, the loss by convection might become still larger, since it was proportional directly to the velocity of the current—at any rate up to the neighbourhood of 1000 ft. per second—while radiation, of course, remained unaffected. He would like to ask the author why engineers persisted in mixing up degrees Fahrenheit and Centigrade in such tables as the excellent one given at the end of the paper.

Mr. Robus asked why the author preferred horizontal boilers to vertical boilers with water gas plants. He also suggested the possibility of heating the water by means of waste heat before it went into the boilers, because it seemed to him that, if it was a paying proposition, it would materially assist in improving the efficiency of the plant.

Mr. F. S. Cargill said that while, as the author had stated, stack temperatures were not a criterion of furnace efficiency, there was the point to remember that a high stack temperature meant loss. He was thinking particularly of carbonizing plants which utilized temperatures up to about 2000°. Last week he had the opportunity of looking over a low-temperature plant in a gas-works; the high-temperature people were not looking, and the engineer informed him that the medium for carbonizing was producer gas at 1,500°. This producer gas was mixed with waste gases at 300°, to get the necessary temperature of 600° or 700°. After these waste gases had done their carbonizing work, they went to a waste-heat recovery boiler for generating steam, which was subsequently superheated and used for boosting-up the carbonizing inside the retort. The point he wished to make was that the gases, when they left the waste-heat boiler, were at a temperature of only 200°.

The Author's Reply.

Major Gregson, replying to the discussion, said that Mr. Reber was one of the foremost experts in the matter of waste-heat recovery, and had had large practical and theoretical experience. As to the Continental design mentioned, he (the speaker) did not know whether they would get it in this country. In this plant the waste gases were split, as mentioned, one-half going direct to the boiler, and the other half to the recuperator, thus cutting down the size of both. He himself had two plants in Holland where the same thing was being tried. The remarks made by Dr. Barratt on radiation were interesting; and he agreed that a great deal more could be done in research upon heat losses by radiation and convection. Dr. Barratt was correct in saying that very little had been done, because, though the big makers such as Woodall-Duckham and Glover-West had done a great deal towards reducing these losses—and the same thing applied to modern horizontal plants—he felt that the steel industry had not made the same attempt to reduce these heat losses as had been made in the gas industry. There were, however, many places where they were actively taking the whole matter in hand. As to why he mixed up Fahrenheit and Centigrade, the reason was that all steam tables were in Fahrenheit, and all pyrometer readings were in Centigrade. With regard to the use of the horizontal boiler on water gas plants, in preference to the vertical boiler, the first consideration was steam space, because, with intermittent water gas plants, unless there were plenty of steam space and considerable water space, there was violent priming with the vertical boiler. The alternative, of course, was to make a vertical boiler for the particular purpose; but then it would mean so much floor space that one might just as well have the horizontal unit. Another point was that, with the vertical boiler, the boiler tube plate was always a source of serious trouble. He agreed with Mr. Cargill that, if there were hot gases coming out of the stack, there would be loss; but there was no more loss than there was in any other type of plant with very low pressures. If they took a modern vertical or a modern horizontal retort installation and cut off the boilers entirely, they would find gases going up the chimney at 800° C. in the case of the vertical plant, and at 400° to 450° C. in the case of the horizontal plant; and yet the vertical plant was the most efficient, because there was more total heat going up the chimney in the case of the horizontal retorts.

YORKSHIRE JUNIOR GAS ASSOCIATION.

Visit to Sheffield.

A Meeting of this Association was held in Sheffield on April 20, when, at the kind invitation of Mr. Ralph Halkett, the General Manager of the Sheffield Gas Company, over seventy members assembled at the Midland Station in the early afternoon. Motor buses were waiting to convey the party to the Coke Oven and Bye-Product Plant at Orgreave, which the Rover Vale Collieries had given permission to inspect. On arrival at the works, the visitors were received by Mr. G. T. Purves, the Manager of the Orgreave Works; and they proceeded on the tour of inspection under the direction of Mr. Purves and Messrs. I. Hurd (Assistant Manager), W. Hislop (Chief Chemist), T. S. Burns (Assistant Chief Chemist), G. Teet and F. Hoyles (Shift Foremen), T. Jones (Foreman Fitter), and T. Prosser (Foreman Electrician).

It was learned that the Sheffield Gas Company were taking over 4 million c.ft. per day from the works, the gas being supplied through a 12-in. main nearly 5 miles long.

After the tour of inspection, the party re-assembled, and Mr. S. H. Packer, the President of the Association, said that before they left the works they would like to express their appreciation of the kindness of the Rover Vale Collieries, and their thanks to Mr. Purves.

Mr. F. Firth, the Senior Vice-President, proposed a vote of thanks to the firm. The visit, he said, had been of great educational value to the members.

Mr. D. T. Livesey, of Doncaster, in seconding the vote, associated himself with the remarks of Mr. Firth, saying that from every point of view the visit had been very successful.

Mr. Purves, in acknowledging the vote, remarked that they were all out for the best efficiency; and unless there was the proper spirit of co-operation with the gas companies who were taking their gas, the best results could not be obtained. They were fortunate in enjoying this co-operation with the Sheffield Gas Company.

The members then returned to Sheffield, proceeding direct to the King's Head Hotel, where they were entertaind at tea by the Sheffield Gas Company.

Mr. Halkett welcomed the members to Sheffield, saying that he had a very warm corner in his heart for the Yorkshire Junior Gas Association. He well remembered the years of close association he had had with them, and he looked back with pleasure to the visits in which he had participated. In the days he referred to 50 p.ct. of the members were really seniors; and he was now pleased to see so many young men as members of the Association; for it was to the young men in the industry that they would have to look in the future. They had seen at Orgreave a plant which was designed and laid out to the best advantage, where ample scope had been left for further development as necessity arose. Coke oven gas had come very much to the front in the last few years. They in Sheffield had been taking coke oven gas for over ten years, and using it very satisfactorily indeed. As Mr. Purves had said earlier in the day, there must be absolute co-operation between the suppliers and the gas undertakings to ensure satisfactory working. It was his opinion that coke oven gas from Orgreave, apart from strikes, could be relied upon equally as well as they could rely upon their own production at the gas-works. Coke oven gas was a national asset which should be used by the gas industry alone. It certainly should not be allowed to go to waste. They in Sheffield were taking supplies from two other sources—Tinsley and the Nunnery Collieries, where the new Becker plant was in operation supplying them with 3½ million c.ft. a day. They had to serve their consumers in the best way; and though they in Sheffield sold cheap gas, it might be possible to sell even cheaper with the aid of more coke oven gas.

Mr. Packer proposed a vote of thanks to the Directors of the Sheffield Gas Company, and to Mr. Ralph Halkett, for the kindness they had shown in inviting the members of the Association to Sheffield, and for their hospitality.

Mr. J. W. Horwill (Junior Vice-President of the Association) seconded the vote.

Mr. Halkett briefly replied.

The President then referred to the serious illness of Mr. C. T. B. Roper, of Bradford, a Past-President of the Association, and an office-bearer over a long period. It would, he said, be the unanimous wish of all the members that a letter of sympathy be sent to Mr. Roper, expressing the hope that he would soon be able to be among them again.

The President announced that the next meeting would be on Saturday, May 11, instead of May 18.

REGISTER OF PATENTS.

Wet Meters.—No. 307,089.

CIE. POUR LA FABRICATION DES COMPTEURS ET MATERIEL D'USINES A GAZ and MILLET, L., both of Paris.

No. 26,120; Oct. 3, 1927.

According to this invention, a wet meter, in order to facilitate the assemblage of internal parts, is characterized by a frame, in one piece, which is secured on the inner partition of the meter. This frame constitutes the front bearing of the measuring wheel, the bearing of all the gears, and, in the case of a constant level meter, the bearing of the liquid elevating apparatus. It contains the gas inlet tube, the curved tube feeding the gas to the measuring wheel, the outflow tube of the overflow device, and its hydraulic guard, and the float valve.

The invention comprises also, in combination with the above, a fluid-tight mechanical connection device between the movable members within the enclosure where the gas flows and the movable members outside; this device being constituted by the combination of the shaft passing through the apparatus with another hollow shaft which covers it and within which is arranged a driving system provided with a spring pressing a shoulder of the shaft against the bearing. This method allows continuous lubrication of the same, to prevent the flowing away of the gas, and, further, applies on the shaft no load other than its own weight, so that this shaft is subjected only to a minimum of stresses.

Gasholders.—No. 307,179.

BROADHEAD, R. W., of Manchester.

No. 3926; Feb. 8, 1928.

The patentee claims: An improved gasholder of the tankless type comprising the combination with a rigid structure of a diaphragm secured thereto at a distance from its base, the said diaphragm being extended above its point of attachment to the structure when the gasholding space is filling, and being capable of falling below its point of attachment when the said space is more or less discharged, and a gas inlet to and a gas outlet from the lower part of the interior of the rigid structure beneath the diaphragm, all arranged substantially as described and illustrated.

Taps.—No. 307,316.

SOUTH METROPOLITAN GAS COMPANY and HARLAND, S. C., both of Old Kent Road, S.E. 15.

No. 29,442; Nov. 3, 1927.

This invention relates to gas taps of the kind comprising a locking lever located wholly on one side of, and pivotally mounted on the handle of, the gas tap.

According to the invention, a single lever is provided which is located entirely on one side of the handle of the gas tap; and the said handle is recessed to receive the finger grip end of the lever, while a blade spring is interposed between the surface of the recess and the face of the finger grip.

Retort-House Governors.—No. 307,565.

GLOVER, W. T., of Oldham, and METERS, LTD., of Manchester.

No. 35,021; Dec. 24, 1927.

This invention relates to retort-house governors having a beam variably loaded to suit varying conditions of working. The object of the invention is to provide improved means for effecting such variable loading; such means being of the known type in which a vessel containing liquid, the level of which can be raised or lowered, is employed upon the tank or the loading beam.

The invention comprises the combination, with the vessel or tank, of a three-way cock and means for its remote control, for the ready adjustment or variation of the liquid contents of the tank to produce the required effect on the governor bell or diaphragm.

Tar Distillation.—No. 307,577.

WILTON, T. O., and THE CHEMICAL ENGINEERING & WILTON'S PATENT FURNACE COMPANY, LTD., both of Victoria Street, S.W. 1.

No. 849; Jan. 10, 1928.

This invention has for its object an improved process and plant. The dehydrated tar coming away from the vapour box is returned by means of a pipe to the crude tar feed tank; the latter being in this case covered by a cover and provided with a supply on the ball and cistern principle, or other analogous device, so that the crude tar is admitted at intervals as required, the level being maintained constant. The plant, when modified in this manner, would cause the tar being treated in the still to return to the feed tank and to become mixed with the crude tar which is being admitted intermittently into the feed tank. This circulation having taken place for a little while, it would be possible for the temperature of the coil still to be raised up to 300° C. or more; the vapours from the vapour box still being condensed in the condenser or condensers until the circulated tar reaches the point where it could be tapped off as soft pitch at a point between the feed tank and the vapour box. The speed at which the tar is tapped off would regulate the speed of admission of the crude tar. An agitator is provided in the feed tank so that the crude tar is thoroughly mixed with the hot dehydrated tar in circulation; and a vapour pipe is provided from the feed tank to the condenser coil or condensers.

Such a plant, say the patentees, could be used to produce the soft pitch required by the new Road Board specifications; it could also be used as a standard plant when distillation is required to be pushed further than is usually the case, so as to increase the specific gravity and viscosity of any type of tar or oil that the plant may be called upon to deal with. The plant may also be used for the manufacture of hard pitch by the adjunct of a steaming pot, in which steam is caused to bubble through the pitch.

Multiple Incandescent Burners.—No. 308,040.

GOULD, F. J., of Grosvenor Place, S.W. 1.

No. 4015; Feb. 8, 1928.

A burner according to this invention comprises the following features in combination: A body member of magnesia clay or like ceramic material with a number of mantle-carrying nozzles of ceramic material at its lower side, and a diffuser disc in each nozzle located at approximately 1½ in. from the nozzle outlet; the burner being made as a unit by forming the body member as a one-piece part and by forming each nozzle in two pieces, one piece of which is integral with the body part and has the other piece screwed and cemented to it.

The patentee claims that thus the gas is very effectively heated, and is supplied under equal pressure to each nozzle; and that the outer part of each nozzle is correctly positioned without liability of displacement of it or the disc.

Sprung Holder for Mantles.—No. 308,112

TRIBE, W. E., of Mansfield.

No. 13,660; May 25, 1928.

In accordance with this invention a mounting or holder for an incandescent gas mantle comprises a member attached in a readily removable manner to the lower end of the burner tube, and adapted to support the mantle or a mantle-supporting member slidably engaging the former tube, through the intermediary of a plurality of spiral springs.

A further feature resides in the provision of radially disposed arms associated both with the member attached to the burner tube and with the mantle or slidable carrier therefor; suitable spiral springs being disposed between the arms of said parts.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for April 4.]

Nos. 9473—10,102.

BLAKELEY, W.—"Gasholders." No. 9486.
BRANDL, H.—"Gas meters." No. 9983.
FIRTH BLAKELEY, SONS, & Co., LTD.—See Blakeley, W. No. 9486.
HELLER, M.—"Generating water gas from powdered fuel." No. 9880.
MARISCHKA, C.—See Brandl, H. No. 9983.
PREMIX GAS PLANTS, LTD.—"Ovens." No. 10,083.

[Extracted from the "Official Journal" for April 10.]

Nos. 10,103—10,728.

ASKANIA-WERKE AKT.-GES. VORM. CENTRALWERKSTATT DESSAU UND C. BAMBERG-FRIEDENAU.—"Gas meters." No. 10,633.
COOPER, C.—"Treatment of heavy oils for washing coal gas." No. 10,174.
COX, F. J.—"Gas stoves." No. 10,237.
EWING, P. A. O.—"Safety device for gas taps." No. 10,540.
HENSHAW, D. M.—See Cooper, C. No. 10,174.
HOLMES & Co., LTD., W. C.—See Cooper, C. No. 10,174.
LICHTENBERGER, T.—"Extraction of gas from fuel." No. 10,691.
MARISCHKA, C.—"Combined gas and steam producer." No. 10,394.
METROPOLITAN FUEL COMPANY, LTD.—See Cox, F. J. No. 10,237.
POOLE, D. C. E.—"Gas meters." No. 10,122.
SOUTH METROPOLITAN GAS COMPANY.—"Steam boilers." No. 10,710.
WILSON, J. H.—See Poole, D. C. E. No. 10,122.

PARLIAMENTARY INTELLIGENCE.

[From Our Special Correspondents.]

GAS UNDERTAKINGS BILL.

Second Reading in the House of Commons, Friday, April 19.

Mr. Herbert Williams (Parliamentary Secretary to the Board of Trade) moved that the Gas Undertakings Bill be read a second time. Referring to the pressing need for new legislation, Mr. Williams said that the gas industry had been suffering under a number of disabilities on account of, it was claimed, antiquated legislation. The National Gas Council (who were a body thoroughly representative of the whole industry, and all interests in the industry) had asked for legislation. Their proposals had been submitted to the National Fuel and Power Committee. That Committee had examined these proposals, and, broadly speaking, had found themselves in favour of them. Some of the proposals, however, were controversial; and it was realized that it would be impossible to carry a controversial Bill through the present Parliament. Therefore an endeavour had been made to select those proposals which were not controversial; and so far as he was aware the clauses of the Bill (which had already passed the House of Lords, and had undergone certain amendment there) represented substantially the non-controversial features of the proposals of the National Gas Council. He then proceeded to explain the clauses.

Mr. A. V. Alexander said he was sorry that Parliamentary exigencies had arisen which prevented the whole question of a much-needed reform in gas legislation being dealt with, because a much more comprehensive measure ought to have been brought forward. The Bill could only be regarded as a stop-gap measure, and there must be a further consideration of the legislation to be enacted by the House, and a much more comprehensive Bill placed upon the Statute Book. There were one or two points upon which he would like to comment. When dealing with an industry which was more or less a monopoly, the House had a duty to perform in seeing that the consumer was not placed in an invidious position. He looked with some anxiety to the exercising of the powers of the Board of Trade to deal with variations in price of gas to the consumer. Another point to which he would like to draw attention was in connection with Clause 5, with regard to helping undertakings outside the limits of the supply undertaking. He would have preferred that the Government, in making such an important change in regard to delimiting supply areas, should have made it subject to the passing of a Special Order, so that it would have had to come before the House at the instance of the Board of Trade. He did not think it would have entailed any appreciably increased cost to the promoters; and it would have been a real safeguard.

Mr. J. Baker thought that Mr. Alexander had overlooked a qualification in the minor amendments with regard to safeguards for the consumer. The Committee on Fuel and Power felt that, while the safeguards might not be absolute, or even complete, the modern development of electricity and the use of oil prevented the consumer from being at the disadvantage at which he was prior to the last ten years. He was satisfied that the Bill was one which ought to be passed in order to help the gas companies, because he believed that in doing so they were going to help the consumer to get cheaper gas.

Mr. Hardie said the Bill was a commercial one. If they had been taking the national point of view, the Bill would have been altogether different. If they had been advancing with the march of science in relation to gas, they would have had a Bill saying that science showed them the best and cheapest way of giving it to the consumer, and it would have contained the means whereby that was to be applied as soon as it could possibly be carried out.

The Bill was read a second time, and committed to a Committee of the whole House.

HOUSE OF LORDS.

Private Bills and Special Orders.

The Imperial Continental Gas Association Bill has been reported from the Committee with amendments, has passed its Third Reading, and was sent to the House of Commons for consideration by the Examiners on April 23.

It is announced that the Promoters do not intend to proceed further with the Aldershot Gas, Water, and District Lighting Bill. The South Suburban Gas Bill has been reported from the Committee without amendment, and is now awaiting Third Reading. The Newcastle-upon-Tyne and Gateshead Gas Bill came before the Unopposed Bills Committee yesterday. The Romford Gas Bill was put down for a Select Committee which met yesterday.

The Second Reading of the Gas Light and Coke Company's Bill and the Winchester Water and Gas Bill were scheduled for yesterday.

The following Special Orders have been referred to the Special Orders Committee: Stockport, Tunbridge Wells, Ulverston, and Southport. The Barnard Castle Gas Order, which has passed the Committee, is still awaiting the Affirmative Resolution.

HOUSE OF COMMONS.

Smokeless Fuel in Government Offices.

Sir R. Thomas asked the Under-Secretary of State for the Home Department, as representing the First Commissioner of Works, if he would state the approximate quantity of fuel consumed annually in the office grates of Government Departments in London; if any steps had yet been taken to substitute "Coalite" or other smokeless fuel for raw coal; and, if not, whether he would take action so that those public institutions could give a lead to private citizens in the matter.

Lieut.-Col. Sir Vivian Henderson, the Under-Secretary of State for the Home Department, said that the quantity of fuel consumed in the office grates of Government Departments in London was approximately 15,000 tons per annum. "Coalite" and other smokeless fuel had been used since the early days of manufacture, and tests were continually being made of new fuels which came into the market.

Gas Undertakings Bill.

The Gas Undertakings Bill was read a second time in the House of Commons on Friday last. The debate lasted about three-quarters of an hour, and all the four speeches made were sympathetic towards the proposals of the Bill. The Bill was referred to a Committee of the whole House, and appeared on the Order Paper nominally for April 22; but in view of the Budget and other financial business, it is not likely to be taken before Friday next. No amendments have yet been put down; but it is understood that one dealing with the breaking-up of roads is to be moved on behalf of the County Council of the West Riding of Yorkshire.

Private Bills and Orders.

The Winchester Water and Gas Bill passed its Third Reading, and has been sent to the House of Lords. The Wandsworth, Wimbledon, and Epsom District Gas Bill, and the Yorktown (Camberley) and District Gas and Electricity Bill passed their Second Readings, and have been referred to Committees.

The following Special Orders have been presented: County Borough of Stockport, Tunbridge Wells Gas Company, and Ulverston Urban District Council.

Congdon Standpipe Patent Renewed.

A patent relating to gas retorts was renewed for three years by Mr. Justice Luxmore in the Chancery Division on April 17.

Mr. Shelley (Barrister) said that the patent concerned a new method of connecting gas retorts by a single pipe instead of a number of pipes. This reduced the difficulty experienced in cleaning. During the war period there had been considerable trouble in placing the invention on the market, as the carrying-out of the patent cost thousands of pounds, and gas undertakings were reluctant to indulge in expensive matters of that sort. Several local authorities had now adopted the patent, which was numbered 9587, and was taken out by Mr. R. W. Congdon, of New York. License to deal with the patent had been granted to Messrs. Aldridge & Ranken, Ltd., of Victoria Street, London.

Gas Exhibition at Thornton.—Opening a gas exhibition at Thornton, on April 17, Councillor W. Betney, J.P., said the progress made in the district during the last 20 years was marvellous. It was over 20 years since the Council erected their gas-works. There were now 2500 consumers for whom 10 miles of gas mains had been laid; the annual output being 60 million c.ft.

Guildford Stock Issue.—As will be seen from an announcement appearing in our advertisement pages, Messrs. A. & W. Richards, of 37, Walbrook, E.C., are offering for sale by tender, under the instructions of the Directors of the Guildford Gas Light and Coke Company, £21,500 5 p.ct. perpetual debenture stock at a minimum price of issue of £91 per £100, yielding at that price £5 9s. 11d. p.ct. The last day for the receipt of tenders is Wednesday, May 1.

MISCELLANEOUS NEWS.

COAL OUTPUT RESTRICTIONS.

Effect of the Five Counties Scheme.

Criticisms of the Five Counties Coal Marketing Scheme made recently by Mr. Joseph Jones, Secretary of the Yorkshire Miners' Association, were replied to on April 16 by Mr. A. W. Archer, one of the leading promoters of the Scheme, who, speaking at Mexborough, said there had been more interference with the British coal industry by trade unions than in any other European coal-producing country. There had been more stoppages and interruptions in British mines since the war than in any other country. In these circumstances the reason for Britain being outpaced was obvious.

There was no evidence to support the allegation that the Five Counties Scheme had displaced a large number of workmen. Long before the Scheme was originated a reduction in the number of mine workers was taking place, and Mr. Jones himself had declared that there were too many mines and too many workers. Mines which could not be worked profitably must soon be closed down whether or not there was a Five Counties Scheme. It was ridiculous to blame the Scheme for short-time working.

Mr. Archer was amazed that Mr. Jones should have made himself responsible for stating that restriction of output and regulation of production was a false and untenable economic theory. He would get little support for such views from the most authoritative economists or from leading industrialists. Without such regulation the industry would have been brought to bankruptcy. Mr. Jones had objected to an international arrangement unless Great Britain secured a quota equal to its 1913 proportion of the European output. That proportion involved the acceptance of regulation of output.

INQUIRY AT MARYPORT.

Proposed Extensions at the Gas-Works.

On April 16, Mr. F. GREGSON WILLIAMS, Assoc.M.Inst.C.E., an Inspector of the Ministry of Health, held an inquiry at the Town Hall, Maryport, into an application from the Maryport Urban District Council to borrow £13,500 for the installation of Glover-West vertical retorts at the gas-works.

Mr. LAIRD, Chairman of the Water Committee, appeared to oppose, and was the only individual doing so.

The INSPECTOR read a cutting from a daily paper that had been sent to the Ministry, which was headed "Threat to Gas-Works," and stated that a moving mountain threatened to crush the works.

Mr. LAIRD: It is perfectly true.

Major *Irwin*, Chairman of the Gas Committee, said there was superficial movement of earth caused by heavy rainfall and defective drainage.

Mr. LAIRD said he was surprised at the calm view Major Irwin had taken of the matter, because recently he asked the Council to build a wall at a cost of about £4000. There was no need for this; and the matter was finally met by the building of a wall at an expense of £1200. The danger had been caused by erecting new purifiers 5 ft. below the level of the foundations of the old wall. Had the earth been taken away, and the water drained, there would have been no need to spend even the £1200.

The INSPECTOR: Do you agree that there is no danger?

Mr. LAIRD: I do.

Mr. *F. G. Bowness* (the Gas Engineer and Manager) described the plant.

Mr. LAIRD said that one holder had been erected 43 years in an exposed position.

Mr. *Bowness* said he had examined the holder and found it in a satisfactory condition. There were one or two patches on the top, and one in the side.

Major *Irwin* and Mr. *Bowness* gave evidence in support of the application, which they said was necessary to increase the output to meet the increased demand, particularly in the winter season.

Mr. LAIRD opposed on the ground that the present gas-works were unsuitable, being in too exposed a position, and that new works should be erected on a new site with access to the Railway, and so save the £400 a year expended at present on cartage.

Major *Irwin* said that the Engineer's estimate was that new works would cost £50,000.

Mr. *F. G. Gaskarth*, a Councillor, pointed out that Mr. Laird's proposed new site would be even more exposed than the present one.

The Inspector afterwards visited the works.

New Gasholder for Keighley.—The Keighley Corporation Gas Department are dismantling an old gasholder at Low Bridge which has been in service for 61 years. It is the last link with the original Keighley Gas-Works started at Low Bridge over a century ago. About two-thirds of the town's gas supply has come from this old holder, but it has shown signs latterly of nearing the end of its term for good service, and is to be replaced by a new one. The old holder had a capacity of 330,000 c.ft., and the new one, which will be completed at the end of July, will be of a similar capacity. Meanwhile, the Department are making use of a booster at the works to maintain the constant pressure which has hitherto been assured by the old holder.

EDINBURGH GAS DEPARTMENT WELFARE CLUB.

Visit to the Gothic Works of Messrs. R. & A. Main, Ltd.

A large party from the Welfare Club of the Edinburgh Gas Department, augmented by lady friends, visited the Gothic Works, Falkirk, on the Edinburgh Spring Holiday, under the guidance of Mr. F. H. Vince, Superintendent of the Granton Gas-Works.

They were divided into small groups, and a tour of inspection of the various departments was carried out; the many and varied processes in modern gas cooker and fire design and construction being closely followed. Keen interest was shown, particularly by the ladies, in the firm's enamelled cookers, with their patent oven and automatic control of the oven heat. Some idea of the efforts which Messrs. Main are expending to better their products and service to the gas industry and their consumers was gathered from the visit.

After the visitors had covered the different departments on the 10-acre works, they were welcomed in the dining hall, newly erected by the firm for the convenience of their workers and staff, by Mr. Worterley, the General Manager.

Mr. A. J. Doran, on behalf of the Welfare Club, expressed thanks to the officials and guides for their services; and the visit terminated with a hearty vote of thanks to the firm, proposed by Mr. Vince on behalf of the Edinburgh Gas Department.

Will.—The late Mr. Percy G. Winstanley, of Bilbrook Cottage, Codsall, Engineer and Manager of the Wolverhampton Gas Company, who died on Feb. 11 last, left estate of the gross value of £5170, with net personalty of £5014.

New Showrooms at Eastthorpe.—The Mirfield (Yorkshire) Gas Company have opened new showrooms at Eastthorpe. The building is of a gabled exterior design, by Mr. T. W. Sharpe, and is particularly attractive. There are two large display windows and two showroom floors inside. The showrooms were opened formally by Mr. H. A. Watson, J.P., Chairman of Directors of the Company. Gas cookery demonstrations are at present being given at the showrooms.

Percy Mort, of Birch Vale, was find £3, or in default three months' imprisonment, by the Stockport Magistrates on April 12 on a charge of stealing £1 19s. 1d. from a slot gas meter at a dwelling-house at Whaley Bridge.

In the Dunfermline Sheriff Court on April 16, Euphemia Husband, of Inverkeithing, was fined 30s., with the alternative of fifteen days' imprisonment, for having stolen the sum of £2 5s. 3d. from the gas meter in her house by opening it with a false key.

The Deal Gas-Works Football Club beat the Depôt R.M. "A" on Saturday, April 13, by 2 goals to *nil* in the "needle" match of the season, thus making sure of the Deal and District Junior League Cup, the Club having lost but three points against the Depôt's four.

At a meeting of the Oswaldtwistle Urban District Council, on April 11, Mr. Lund asked if a promise had been received from the Blackburn Corporation to lay a new gas main to Belthorn. The Clerk said the Blackburn Gas Manager had promised the matter would receive attention.

A verdict of "Accidental death" was returned at the inquest on James Wiggan (64), a stoker of 45 years' service at the Blackpool Corporation Gas-Works, on April 16. It was stated that deceased had returned from work complaining of a pain in the shoulder, which he said he had knocked.

Six persons were overcome by an escape of gas in a house in Aybrook Street, Marylebone, on April 7, and had to be removed to hospital, the condition of one being serious. The escape was detected by police officers, who summoned ambulances when it was found that the occupants of the house had been overcome.

When a number of juveniles were summoned at West Hartlepool on April 17, for having thrown stones and damaged gas lamps and electric bulbs, a representative of the Hartlepool Gas and Water Company stated that since November last 500 gas lamps had been broken, of which a total of 54 had been broken during the past fortnight.

The scheme for the popularizing of gas appliances by the establishment of a gas showroom at Blackpool was advanced a stage further recently, when representatives of the Blackpool Corporation Gas Committee met delegates from the Master Plumbers and the Chamber of Trade. As the result of the joint conference it is hoped that arrangements will be reached satisfactory to all parties.

An interesting gathering took place recently at Frascati's Restaurant, where a dinner was given by the Davis Gas Stove Company, Ltd., to Mr. George Goatley, who is 86 years of age, and has been in the firm's service for nearly 50 years, and to other employees who have been with the firm over 30 years. There were present 27 members of the staff. Mr. Cyril G. Davis, the Managing Director, was in the chair; and the evening was a happy and successful one.

TRADE NOTES.

Gasification Plant for Lochgilphead.

Messrs. Tully, Sons, & Co., Ltd., of Newark, have received an order for a small mechanically operated gasification plant for the Lochgilphead Gas Company, who intend to supply to the town straight Tully gas.

A Catalogue of Distinction.

The 1929 Gas Cooker List published by Messrs. R. & A. Main, Ltd., of London and Falkirk, is beautifully printed and profusely illustrated. It demonstrates clearly the extraordinary progress which has been made of late years in gas cooker finishes and general construction, and is evidence of the fact that Messrs. Main are in the vanguard of gas appliance design and performance.

Keith High-Pressnre Gas Lighting.

The March list of high-pressure gas lamps of Messrs. Keith & Blackman Company, Ltd., gives some useful information regarding the developments and advantages of high-pressure gas lighting for all purposes. The list contains full particulars of cost and design of different types of lamp, together with a graph showing the greater efficiency of these lamps when compared with electric lighting.

The Prevention of Vibration and Noise.

All moving machinery creates some form of vibration more or less disturbing to the surroundings. Preventing the transmission of vibrations has been the study of Messrs. W. Christie & Grey, Ltd., of Lloyds Avenue, E.C. 3, for the past 18 years, and their methods, based on this wide experience, have been, they claim, most successful. These methods have been applied to machinery ranging from the largest Diesel engines to small oil engines; from turbo-alternators to small motor generators; and all types of ventilating plant and industrial machinery operating all over the world. Wherever vibration and noise have to be considered, the application of suitable methods will successfully prevent transmission to the surroundings.

"W-D" Verticals for Aberdeen and Wellington (Salop).

On the recommendation of their Engineer, Mr. Samuel Milne, the Aberdeen Corporation Gas Department have placed an order with the Woodall-Duckham Vertical Retort and Oven Construction Company (1920), Ltd., for an installation of "W-D" continuous vertical retorts with a carbonizing capacity of 308 tons per day. The installation will comprise 28 103-in. retorts, erected in a new steel-frame brick-built retort house, and will be complete with coal and coke handling plant, coke screening and storage hoppers, and waste-heat boilers. The Wellington (Salop) Gas Company have also placed an order with the Woodall-Duckham Company for an extension of four "W-D" continuous vertical retorts to be built at the end of the existing bench.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

London, *April 22.*

The revival in inquiry for pitch which has been noticeable of late has continued during the past week. Prices quoted and paid for shipment during the late months of the year have been decidedly firmer. There are no changes to report in other products.

Creosote remains about 6½d. per gallon.

Tar spirits are also unaltered; pure benzole being 1s. 11d. to 2s. per gallon, pure toluole 2s. 1d. to 2s. 2d., and 95/160 solvent naphtha about 1s. 7d. to 1s. 8d.

Pyridine bases are about 4s. per gallon.

Tar Products in the Provinces.

April 22.

The average prices of gas-works products during the week were: Gas-works tar, 18s. to 23s. Pitch—East Coast, 31s. 6d. to 32s. 6d. f.o.b. West Coast—Manchester, 26s. 6d. to 27s.; Liverpool, 28s. 6d. to 29s. 6d.; Clyde, 28s. 6d. to 29s. 6d. Toluole, naked, North, 1s. 7¼d. to 1s. 8¼d. Coal-tar, crude naphtha, in bulk, North, 9d. to 10d. Solvent naphtha, naked, North, 1s. 3⅞d. to 1s. 4¼d. Heavy naphtha, North, 1s. to 1s. 0½d. Creosote, in bulk, North, liquid, 3⅞d. to 4¼d.; salty, 3½d. to 3⅝d.; Scotland, 3⅞d. to 4¼d. Heavy oils, in bulk, North, 6d. to 6½d. Carbolic acid, 60 p.ct., 1s. 10d. to 1s. 10½d. prompt. Naphthalene, £13 to £15; salts, £5 to £5 10s., bags included. Anthracene, "A" quality, 2½d. per minimum 40 p.ct., purely nominal; "B" quality, unsaleable.

Benzole Prices.

The following are considered to be the market prices to-day:

	s. d.	s. d.	
Crude benzole . . .	1 0	to 1 1	per gallon at works
Motor ,, . . .	1 7	,, 1 8	,, ,, ,,
90 p.ct. ,, . . .	1 9	,, 1 10	,, ,, ,,
Pure ,, . . .	2 0	,, 2 1	,, ,, ,,

Street Lighting at Easebourne.—A proposal for street lighting was discussed at a meeting of the Easebourne Parish Council recently. For reasons of economy the erection of only four standards was recommended at first, and for these, two quotations had been received—£8 a lamp for electric light, and £4 a lamp from the Midhurst Gas Company.

COAL TRADE REPORTS.

From Our Own Correspondents.

NORTH-EAST COAST.

The demand for coal generally is holding up remarkably well, and current values, while naturally below the recent highest, are considerably above last year's average. The day-to-day demand remains good, and collieries are still able to stem up for a week or two ahead. At the same time, inquiry for longer periods is on a satisfactory scale, and business is being steadily and quietly booked for the remainder of the year. There is talk of wages and hours questions in both Poland and the Ruhr; and this is helping the market to a certain extent.

Gas coal collieries are well stemmed on the whole, and prospects appear quite good for May. Wear Specials quote 16s. 6d. f.o.b., and best qualities 15s. 6d. to 15s. 9d. Seconds are 15s. to 15s. 6d. Coking coal is still the feature of the Durham market at 15s. 9d. to 16s., and this price can be obtained for some way ahead. Best unscreened bunker makes are round 16s. 6d. to 17s., with seconds at 15s. 6d. Northumberland best screened steams ask 16s. f.o.b. for prompt.

Gas coke is quiet, and is quoted at 19s. f.o.b. for shipment.

YORKSHIRE AND LANCASHIRE.

Contract supplies of gas coal are fully adequate. Industrial fuel is in moderate demand at recent values. The collieries anticipate renewals of contracts at prices slightly exceeding those made a short time ago. The shipping market is quiet, with values easier.

In consequence of increased production, the position from the buyer's standpoint has become easier. Slight reductions are made for prompt, and buyers are more inclined to press their inquiries on forward account.

The following are the Humber bunker and export prices, f.o.b. usual shipping ports:

South Yorkshire—Hards, Association, bunkers 20s. 9d. to 21s., export 17s. 6d.; screened gas coal, export 17s. to 17s. 6d.; washed trebles, export 17s. 6d.; washed doubles, bunkers 19s., export 15s. 9d. to 16s. 3d.; washed singles, export 15s.; washed smalls, bunkers 15s., export 12s.; rough slack, bunkers 13s. 6d. to 13s. 9d., export 11s. to 11s. 6d.; smithy peas, export 17s. to 18s.

West Yorkshire—Hartley's (f.o.b. Goole), bunkers 17s. 6d., export 16s.; screened gas coal, export 17s.; washed trebles, export 17s.; washed doubles, export 15s. to 15s. 6d.; washed singles, export 14s. 6d. to 15s.; washed smalls, bunkers, 14s. 9d., export 11s. to 11s. 6d.; unwashed trebles, export 16s. 6d.; unwashed doubles, export 13s. 6d. to 14s.; rough slack, bunkers 13s. 6d., export 9s. to 9s. 6d.; coking smalls, export 9s. to 9s. 6d..

Derbyshire and Nottinghamshire—Top hards, bunkers 20s. to 20s. 9d., export 17s. to 17s. 6d.; cobbles, export 16s. to 17s.; washed trebles, export 16s. 6d. to 17s.; washed doubles, export 13s. 3d. to 13s. 9d.; washed singles, export 14s. 3d. to 14s. 9d.; washed smalls, bunkers 14s. 9d. to 15s., export 11s. 6d.; unwashed doubles, export 14s. to 14s. 6d.; rough slack, bunkers 13s. 3d. to 13s. 9d., export 9s. 6d. to 10s. 6d.

Yorkshire, Derbyshire, and Nottinghamshire—Screened steam coal, bunkers 18s. to 18s. 6d., export 16s. to 17s.; gas coke, export 19s. 6d. to 21s. 6d.; furnace coke, export 20s.; washed steam (Goole, West Yorkshire), bunkers 18s.; (Hull, West Yorkshire), bunkers 18s. 6d.; (Hull, South Yorkshire), bunkers 18s. 9d. to 19s., export 16s.

MIDLANDS.

Although seasonal displacements involve market irregularities, and spot lots are on offer at less than the rates generally quoted, the even balance of supply and demand is on the whole maintained. Less labour suffices for the collieries. Most of those in the Five Counties Scheme appear to be raising their full quota.

Best grades of house coal are still being called for. They have been little affected by the price depreciation which has marked the course of business this month. Medium qualities are obtainable in the case of spot lots at about 1s. less than the rates lately quoted.

Industrial coal is in good supply, and prices are easy without noticeable decline. Quotations for steams and annealing qualities are showing wider variations according to local circumstances, and the demand is more than maintained. Slacks are plentiful. Two-inch can be bought at 5s. 6d. to 9s. "D.S." nuts fetch 11s. 6d. upwards, according to quality.

Prompt supplies of furnace coke can be got if consumers are willing to pay something like 16s. at the ovens. The easing of the position does not make much progress, however.

With the return of "summer time" many gas undertakings are taking reduced deliveries of coal. The business passing is very small.

CONTRACTS OPEN.

Coal.

Tenders are invited by the Borough of East Retford for coal. [See advert. on p. 217.]

Oxide of Iron.

The Colwyn Bay Urban District Council are inviting tenders for the supply of oxide of iron. [See advert. on p. 217.]

Tar.

The Hertford Gas Light Company invite tenders for tar. [See advert on p. 217.]

STOCK AND SHARE LIST.

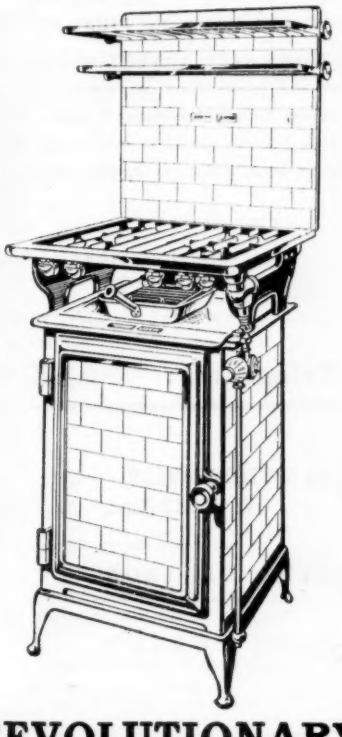
[For Stock Market Report, see earlier pages.]

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. Apl. 19.	Rise or Fall on Week.	Transactions Lowest and Highest Prices.
£			%p.a	% p.a.				
171,878	Stk.	Feb 7	6	6	Aldershot 5 p.c. max. C.	70—75	..	..
412,992	,,	,,	4	4	Do. 4 p.c. Pref.	73—76	..	..
1,561,868	,,	Apl. 11	7½	7½	Alliance & Dublin Ord.	97—100*	..	98—98½
274,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb.	63—66	..	..
692,555	,,	Mar. 7	7	7	Barnet Ord. 7 p.c.	112—115	..	..
800,000	1	Oct. 11	1/7½	1/4½	Bombay, Ltd.	20/—22/-	..	21/—21/6
172,500	10	Mar. 7	8½	9	Bournemouth 5 p.c.	12¾—13½	..	..
800,050	10	,,	7	7	Do. B 7 p.c.	12¾—13½	..	..
439,160	10	,,	6	6	Do. Pref. 6 p.c.	10¾—11½	..	..
80,000	Stk.	Jan. 10	3	3	Do. 3 p.c. Deb.	55—58	..	..
153,025	,,	,,	4	4	Do. 4 p.c. Deb.	74—77	..	..
857,900	,,	Mar. 21	7½	7½	Brighton & Hove 6 p.c. Con.	113—116	..	..
271,880	,,	,,	6½	6½	Do. 5 p.c. Con.	99—102	..	..
1,387,500	,,	Feb. 21	5	5	Bristol 5 p.c. max.	89—90a	+½	..
885,000	,,	Apl. 11	8	7½	British Ord.	116—119*	..	117½—118½
100,000	,,	Dec. 20	7	7	Do. 7 p.c. Pref.	115—120	..	..
100,000	,,	,,	4	4	Do. 4 p.c. Red. Deb.	73—76	..	..
200,000	,,	,,	5	5	Do. 5 p.c. Red. Deb.	93—96	..	95½
100,000	10	Dec. 6	8	6	Cape Town, Ltd.	8—9	..	..
100,000	10	Oct 25	4½	4½	Do. 4½ p.c. Pref.	6¾—7½	..	..
150,000	Stk.	Dec. 20	4½	4½	Do. 4½ p.c. Deb.	73—78	..	..
695,860	,,	Feb. 21	3	6	Cardiff Con. Ord.	97—100	..	..
997,860	,,	Jan. 10	7½	7½	Do. 7½ p.c. Red. Deb.	100—103	..	..
187,150	,,	Feb. 21	5	6½	Chester 5 p.c. Ord.	88—93b	+½	..
98,936	1	Oct. 11	12/-	12/-	Colombo Ltd. Ord.	36/—38/-	..	..
24,495	1	,,	1/4½	1/4½	Do. 7 p.c. Pref.	21/—23/-	..	..
275,402	1	Apl. 11	1/9½	1/9½	Colonial Gas Assn. Ld. Ord.	24/—26/-*	..	..
187,548	1	,,	1/7½	1/7½	Do. 8 p.c. Pref.	20/—22/-*	..	..
2,073,280	Stk.	Feb. 21	5	7	Commercial Ord.	98—101	..	98½
475,000	,,	Dec. 20	8	8	Do 8 p.c. Deb.	56—59	..	..
800,000	,,	Sept. 27	11	11	Continental Union, Ltd.	119—124	+1	121—123
200,000	,,	,,	7	7	Do. 7 p.c. Pref.	123—128	..	124—126
197,580	,,	Feb. 21	7	7	Croydon sliding scale	110—113	..	..
405,100	,,	,,	5	5	Do. max. div.	83—86	..	..
542,270	,,	Mar. 7	7	10	Derby Con.	112—117e	..	..
55,000	,,	Dec. 20	4	4	Do. Deb.	70—72e	..	..
800,000	,,	Mar. 7	5	5	East Hull Ord. 5 p.c.	73—76	..	..
1,003,180	10	Mar. 21	†4	†7	European, Ltd.	17—19	—½	16½—18
15,705,480	Stk.	Feb. 21	5½	5½	Gas Light & Coke 4 p.c. Ord.	19/—19/6f	..	19/1½—19/6½
2,000,000	,,	,,	8½	8½	Do. 8½ p.c. max.	63—65	..	64½—65
4,157,020	,,	,,	4	4	Do. 4 p.c. Con. Pref.	75—77	—1	75½—76½
6,000,620	,,	Dec. 20	8	8	Do. 8 p.c. Con. Deb.	58½—60½	..	59½—60½
3,642,770	,,	,,	5	5	Do. 5 p.c. Red. Deb.	98—101	..	99½—101½
60,500	,,	Mar. 21	7	7	Hastings & St L. 5 p.c. Conv	98—103	+2	..
388,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	80—85	+3	..
70,000	10	Oct. 11	†10	†10	Hongkong & China, Ltd.	13½—14½	+½	..
312,200	Stk.	Mar. 7	5½	6	Hornsey Con. 3½ p.c.	86—89	..	..
1,916,000	,,	Nov. 8	10	10	Imperial Continental Cap.	390—410	..	395—405
228,150	,,	Feb. 7	8½	8½	Do. 8½ p.c. Red. Deb.	70—73	+1	..
395,242	,,	Mar. 7	7½	8	Lea Bridge 6 p.c. Ord.	117—120	..	..
2,146,907	,,	Feb. 21	6½	6½	Liverpool 5 p.c. Ord.	94½—95½b	..	..
600,000	,,	Mar 21	7	7	Do. 7 p.c. Red. Pref.	100—102b	..	..
166,736	,,	Feb. 21	9	8	Maidstone 5 p.c. Cap.	124—129	..	..
63,480	,,	Dec. 20	3	3	Do. 3 p.c. Deb.	54—57	..	..
75,000	5	Dec. 6	18	18	Malta & Mediterranean Metrop't'n (of Melbourne)	6½—6¾	..	..
393,000	—	Apl. 2	—	5½	5½ p.c. Red. Deb.	98—100	..	..
641,920	Stk.	Nov. 22	†7	†5	Montevideo, Ltd.	106—109	+1	107
1,031,312	,,	Feb. 21	5	5½	Newcastle & Gateshead Con.	17/9—18/3d/f	+/3	..
682,856	,,	,,	4	4	Do. 4 p.c. Pref.	73½—74½d	+½	..
691,705	,,	Dec. 20	8½	8½	Do. 8½ p.c. Deb.	69¼—70½d	+1½	..
131,750	,,	Mar 7	7/1/0	7/1/0	North Middlesex 6 p.c. Con.	105—110	..	..
800,000	,,	Nov. 22	7	9	Oriental, Ltd.	116—120	..	118½—119
166,130	,,	Dec. 20	7½	8	Plym'th & Ston'house 5 p.c.	112—115	..	..
424,416	,,	Feb. 21	7½	8½	Portsm'th Con. Stk. 4 p.c. Std.	113—118	..	..
341,446	,,	,,	5	5	Do. 5 p.c. max.	82—85	+1	83
2,334,464	1	—	—	—	Primitiva Ord.	33/6—35/6	+1/-	32/-—35/3
244,500	100	Dec. 3	4	4	Do. 4 p.c. Red. Deb.	91—94	..	..
695,000	Stk.	Jan. 24	4	4	Do. 4 p.c. Red. Deb. 1911	78—80	..	..
416,845	,,	Dec. 20	4	4	Do. 4 p.c. Cons. Deb.	78—80	..	80
160,000	10	Mar. 21	6	8	San Paulo 6 p.c. Pref.	8½—8¾	..	..
1,736,968	Stk.	Mar. 21	6½	6½	Sheffield Cons.	106—108e	..	..
95,000	,,	Jan. 10	4	4	Do. 4 p.c. Deb.	74—77e	..	..
99,000	10	June 14	:3	:4	South African	4—6	..	..
6,902,895	Stk.	Feb. 21	6	7½	South Met. Ord.	104½—105½	..	104¾—105¾
500,000	,,	,,	6	6	Do. 6 p.c. Irred. Pf.	108—111	..	109
1,995,445	,,	Jan. 10	8	8	Do. 8 p.c. Deb.	58—60	..	58¾—59½
784,000	,,	Mar. 7	6½	6½	Do. 6½ p.c. Red. Db.	99—101	..	..
91,500	,,	Mar. 7	8½	8½	South Shields Con.	106½—107½d	..	..
1,542,795	,,	Feb. 21	6½	6½	South Suburban Ord. 5 p.c.	107—110	..	110
468,337	,,	Dec. 20	5	5	Do. 5 p.c. Deb.	97—100	—1	99
847,740	,,	Mar. 7	5	5	South'mpton Ord. 5 p.c. max.	77—80	..	79—79½
131,278	,,	Dec. 20	4	4	Do. 4 p.c. Deb.	72—75	..	..
850,000	,,	Feb 21	7	7	Swansea 7 p.c. Red. Pref.	100—102	..	101
900,000	,,	Dec. 20	6½	6½	Do. 6½ p.c. Red. Deb.	100—102	..	102
1,004,275	,,	Mar. 7	—	6½	Tottenham District Ord.	105—108	..	106½
180,000	,,	,,	5½	5½	Do. 5½ p.c. Pref.	95—98	..	..
181,255	,,	Dec. 6	4	4	Do. 4 p.c. Deb.	75—78	..	78
389,094	,,	Mar 7	6¾	7	Uxbridge, Maidenhead, & Wycombe 5 p.c.	93—98	..	..
98,880	,,	,,	5	5	Do. 5 p.c. pref.	85—90	..	..
80,000	,,	Feb. 21	8½	9	Wandsworth, Wimbledon, and Epsom— Wandsworth A 5 p.c.	147—152	..	..
955,686	,,	,,	7½	7½	Do. B 8½ p.c.	125—130	..	..
422,625	,,	,,	6½	6½	Do. C and New	102—107	..	..
353,000	,,	,,	6¾	7½	Do. Wimbledon 5 p.c.	115—120	..	119
96,000	,,	,,	7½	7½	Do. Epsom 5 p.c.	126—131	..	..
300,000	,,	,,	5	5	Do. 5 p.c. Pref	90—95	..	..
88,416	,,	Dec. 20	8	8	Do. 8 p.c. Deb.	56—59	..	..
184,748	,,	,,	4	4	Do. 4 p.c. Deb.	77—80	..	..
307,560	,,	,,	5	5	Do. 5 p.c. Deb.	97—100	..	..

Quotations at:—a.—Bristol. b.—Liverpool. c.—Nottingham. d.—Newcastle. e.—Sheffield. .—The quotation is per £1 of Stock. * Ex. div † Paid free of income-tax. ‖ For year.

Governor-General

GAS COOKER



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with WHITE CONE Dial

GENERAL GAS APPLIANCES LIMITED

Guide Bridge Manchester

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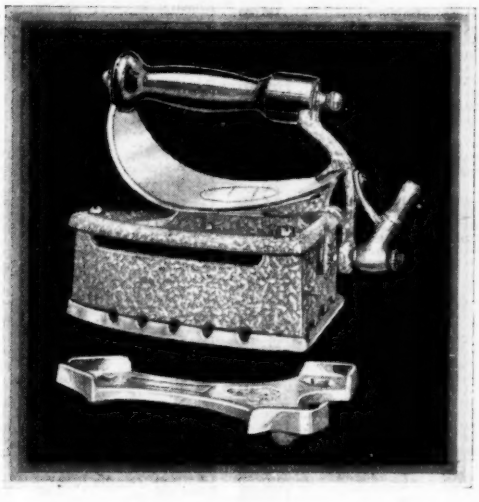

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Abertillery ..	500,000
Abertillery ..	100,000
Admiralty:	
British	800,000
British	800,000
British	800,000
British	800,000
British	800,000
French	800,000
Agram	200,000
Airdrie	450,000
Aldershot	1,400,000
Aldershot	1,000,000
Aldershot	1,316,000
Alkmaar	400,000
Allenstein	200,000
Alost	700,000
Amersfoort ..	300,000
Amsterdam ..	1,000,000
Amsterdam ..	1,000,000
Amsterdam ..	2,700,000
Antwerp	1,500,000
Antwerp	1,000,000
Antwerp	1,500,000
Antwerp	1,900,000
Ascot	423,000
Ashford	250,000
Asnières	650,000
Augsburg	425,000
Aylesbury	150,000
Aylesbury	470,000
Banbury	200,000
Banff	125,000
Barmen	500,000
Barnsley	588,000
Barrow	300,000
Barrow	500,000
Barry	500,000
Barry	720,000
Bath	1,000,000
Bath	1,000,000
Bath	1,300,000
Belfast	1,700,000
Belfast	4,500,000
Belfast	1,250,000
Belfast	1,250,000
Belfast	2,250,000
Bennrath	125,000
Berkhampstead ..	259,000
Berlin:	
Charlottenb'g ..	2,500,000
Danziger Str. ..	1,600,000
Neukoelln ..	650,000
Neukoelln ..	700,000
Schmargendorf	760,000
Tegel	3,500,000
Tegel	6,350,000
Tegel	245,000
Bideford	258,000
Bilston	375,000
Bilston	125,000
Birmingham:	
Adderley St. ..	675,000
Nechells	3,000,000
Nechells	3,000,000
Nechells	3,000,000
Swan Village ..	1,500,000
Windsor St. ..	3,000,000
Windsor St. ..	3,000,000
Bishop's Stortford	200,000
Bishop's Stortford	300,000
Bishop's Stortford	200,000
Blackburn	1,190,000
Blantyre	150,000
Blois	125,000
Blois	125,000
Bochum	530,000
Bognor	100,000
Bognor	423,000
Bo'ness	125,000
Boulogne	340,000
Bournemouth ..	1,000,000
Bournemouth ..	500,000
Bournemouth ..	1,500,000
Bournemouth ..	1,000,000
Bournemouth ..	500,000
Bournemouth ..	1,530,000
Bournemouth ..	2,000,000
Bournemouth ..	500,000
Bournemouth ..	2,750,000
Bremen	550,000
Bremen	950,000
Bremen	850,000
Brentwood	250,000
Brescia	588,000
Brest	550,000
Bridgwater ..	200,000
Bridlington ..	150,000
Bridlington ..	200,000
Bridlington ..	550,000
Brieg	100,000
Brierley Hill ..	250,000
Brighton	1,750,000
Brighton	1,850,000
Brighton	750,000
Brighton	2,750,000
Bristol	2,000,000
Bristol	2,500,000
Bristol	825,000
Bristol	825,000
Bromley	1,500,000
Bruges	200,000
Bruges	600,000
Brussels:	
Anderlecht ..	350,000
Anderlecht ..	350,000
Forest	1,000,000
Forest	1,000,000

	Cu. Ft. Daily
Forest	1,000,000
Forest	1,500,000
Forest	88,000
Koehelberg ..	1,000,000
St. Gilles ..	1,000,000
St. Josse	1,000,000
St. Josse	900,000
St. Josse	775,000
Ville	750,000
Ville	750,000
Ville	1,500,000
Ville	350,000
Bucarest	1,100,000
Buckie	164,000
Budapest	50,000
Budapest	1,750,000
Budapest	300,000
Budapest	250,000
Caen	250,000
Cambridge	500,000
Cambridge	1,000,000
Cardiff	2,000,000
Cardiff	3,000,000
Cardiff	1,950,000
Cardiff	600,000
Carlisle	600,000
Carlsruhe	500,000
Carnarvon	348,000
Charleroi	1,250,000
Châteauroux ..	125,000
Châteauroux ..	125,000
Châtelet	500,000
Chester	564,000
Chesterfield ..	430,000
Chesterfield ..	90,000
Chesterton ..	197,000
Chichester	250,000
Chorley	300,000
Cie. des Compteurs	1,150,000
Cie. Lorraine de Ch.	210,000
Cie. Minesde Roche	585,000
Coatbridge	400,000
Commercial, L'n	850,000
Commercial ..	850,000
Commercial ..	1,250,000
Commercial ..	2,000,000
Commercial ..	800,000
Commercial ..	2,100,000
Copenhagen ..	700,000
Copenhagen ..	2,500,000
Copenhagen ..	1,750,000
Courtrai	250,000
Coventry	600,000
Coventry	600,000
Coventry	800,000
Coventry	1,250,000
Coventry	350,000
Cowdenbeath ..	420,000
Cracow	200,000
Cracow	200,000
Cranleigh	188,000
Crefeld	500,000
Crewe	700,000
Crewe	800,000
Crosfield & Sons ..	1,500,000
Crosfield & Sons ..	1,500,000
Crowborough ..	150,000
Croydon	1,250,000
Croydon	625,000
Croydon	625,000
Croydon	550,000
Croydon	650,000
Croydon	1,125,000
Croydon	150,000
Croydon	3,000,000
Deal	250,000
Deal	250,000
Debreczin	100,000
Derby	1,500,000
Derby	2,000,000
Deventer	150,000
Deventer	200,000
Devonport	1,600,000
Devonport	1,100,000
Doncaster	1,350,000
Dorking	150,000
Dorking	300,000
Dorking	130,000
Dover	500,000
Dublin	2,000,000
Dublin	2,000,000
Dublin	650,000
Dudley	600,000
Dundee	1,500,000
Dunedin, N.Z. ..	150,000
Dunedin	275,000
Durham	200,000
Dusseldorf	1,000,000
Eastbourne ..	1,250,000
Eastbourne ..	1,550,000
Edinburgh	2,000,000
Eindhoven	1,500,000
Enschede	282,000
Epsom	225,000
Epsom	300,000
Essen	1,400,000
Essen-Borbeck ..	1,400,000
Exeter	1,100,000
Exmouth	376,000
Falmouth	150,000
Faversham	200,000
Flensburg	300,000
Flensburg	125,000
Forst	300,000
Frankenthal ..	175,000

	Cu. Ft. Daily
Fuel Research Wks.	500,000
Fuel Research Wks.	500,000
Furnes	500,000
Gabions	140,000
Gas L. & C. Co.:	
Beckton	10,000,000
Beckton	7,000,000
Beckton	3,500,000
Beckton	7,000,000
Beckton	7,000,000
Beckton	5,250,000
Beckton	4,500,000
Beckton	3,000,000
Bow Common ..	1,000,000
Bow Common ..	1,150,000
Bow Common ..	150,000
Brentford	1,200,000
Brentford	850,000
Brentford	350,000
Brentford	750,000
Bromley	3,750,000
Bromley	2,250,000
Bromley	1,000,000
Bromley	1,000,000
Bromley	1,000,000
Bromley	1,450,000
Bromley	1,350,000
Fulham	2,500,000
Fulham	1,700,000
Ilford	650,000
Ilford	750,000
Kensal Green ..	2,250,000
Kensal Green ..	2,250,000
Kensal Green ..	2,250,000
Nine Elms ..	2,750,000
Nine Elms ..	750,000
Nine Elms ..	1,870,000
Nine Elms ..	2,850,000
Shoreditch ..	900,000
Shoreditch ..	2,700,000
Shoreditch ..	2,725,000
Southall	2,000,000
Southall	3,000,000
Staines	600,000
Stratford	1,700,000
Stratford	850,000
Stratford	2,350,000
Stratford	2,350,000
Gelsenkirchen ..	175,000
Gelsenkirchen ..	350,000
Geneva	500,000
Geneva	700,000
Gennevilliers ..	10,600,000
Gennevilliers ..	2,900,000
Girvan	235,000
Glasgow	3,000,000
Glasgow	2,500,000
Glasgow	2,250,000
Glossop	340,000
Gloucester	800,000
Gloucester	1,000,000
Gosport	200,000
Gosport	225,000
Göteborg	300,000
Göteborg	600,000
Graudenz	200,000
Grays	250,000
Grays	400,000
Groningen, Holland	500,000
Guest Keen & Piggotts, Ltd.	1,936,000
Guildford	300,000
Guildford	200,000
Guildford	350,000
Guildford	1,100,000
Guildford	150,000
Haarlem	850,000
Hamburg	1,750,000
Hampton Court ..	500,000
Hampton Court ..	600,000
Hampton Court ..	1,100,000
Hanley	800,000
Hanley	800,000
Hartlepool	750,000
Hartlepool	765,000
Haywards Heath ..	470,000
Hebden Bridge ..	200,000
Heidelberg	200,000
Hereford	525,000
Hertford	197,000
Hertford	244,000
Hessle	150,000
High Wycombe ..	752,000
Hilversum	850,000
Hinckley	250,000
Holyhead	197,000
Hong Kong ..	450,000
Hong Kong ..	450,000
Hornsey	1,000,000
Hornsey	1,000,000
Hornsey	750,000
Hornsey	750,000
Horsham	235,000
Hull	1,500,000
Hull	1,000,000
Hull	1,500,000
Innsbruck	200,000
Ipswich	750,000
Ipswich	1,250,000
Jersey	664,000
Kampen	350,000
Karlsbad	350,000
Kendal	329,000

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Kidsgrove	235,000
Kiel	1,000,000
Kiel	880,000
Kilmarnock ..	500,000
Kilmarnock ..	585,000
King's Lynn ..	197,000
Kirkintilloch ..	360,000
Kirkintilloch ..	827,000
Kolozvar	100,000
Lancaster	500,000
Largs	235,000
Lausanne	250,000
Lausanne	385,000
Le Mans	420,000
Lea Bridge	350,000
Lea Bridge	350,000
Lea Bridge	400,000
Lea Bridge	1,000,000
Lea Bridge	1,500,000
Lea Bridge	1,530,000
Leamington	600,000
Leamington	525,000
Leatherhead ..	705,000
Leeds	1,500,000
Leeuwarden	400,000
Leiden	500,000
Leiden	575,000
Leigh	350,000
Lemberg	260,000
Lemberg	500,000
Letchworth	362,000
Letchworth	423,000
Liége	1,000,000
Liége	750,000
Lille	860,000
Lincoln	500,000
Lincoln	893,000
Liverpool	3,500,000
Liverpool	4,500,000
Liverpool	750,000
Liverpool	1,750,000
Liverpool	1,250,000
Liverpool	3,000,000
Liverpool	1,500,000
Liverpool	1,250,000
Liverpool	2,350,000
Long Eaton	430,000
Long Eaton	170,000
Longton	600,000
Louvain	800,000
Lubeck	400,000
Luton	400,000
Maastricht	200,000
Macclesfield ..	800,000
Magdeburg	1,400,000
Maidenhead ..	225,000
Maidenhead ..	225,000
Maidenhead ..	175,000
Maidenhead ..	175,000
Maidstone	500,000
Maidstone	500,000
Malines	500,000
Malines	575,000
Maluó	350,000
Malta	400,000
Manchester	3,500,000
Manchester	3,500,000
Manchester	1,500,000
Mansfield	330,000
Mansfield	493,000
Marlborough ..	100,000
Mayence	700,000
Melbourne	5,000,000
Merthyr Tydfil ..	300,000
Merthyr Tydfil ..	200,000
Middlesbrough ..	1,250,000
Middlesbrough ..	750,000
Middlesbrough ..	900,000
M/M. Woolston ..	9,000,000
Monaco	275,000
Monaco	618,000
Mons	500,000
Montevideo	1,222,000
Morecambe	333,000
Moscow	1,000,000
Munich	1,400,000
Namur	175,000
Narbonne	350,000
Nelson	400,000
Neuss	140,000
Newbury	250,000
Newcastle	2,500,000
Newcastle, N.S.W.	500,000
Newport Pagnell ..	188,000
Nice	900,000
Nictheroy	250,000
N. Middlesex ..	150,000
N. Middlesex ..	200,000
N. Middlesex ..	75,000
N. Middlesex ..	650,000
N. Middlesex ..	650,000
N. Middlesex ..	1,000,000
Northfleet	235,000
North Sydney ..	500,000
North Sydney ..	500,000
Norwich	1,000,000
Norwich	300,000
Norwich	500,000
Norwich	1,500,000
Nottingham	1,000,000
Nottingham	1,000,000
Nuneaton	125,000
Oberhausen	175,000
Oldbury	500,000
Oldenburg	200,000

	Cu. Ft. Daily
Ormskirk	176,000
Ostend	100,000
Ostend	200,000
,, Zandvoorde	700,000
Palermo	968,000
Palermo	850,000
Paris:	
Clichy	4,000,000
Ivry	1,570,000
Landy	6,000,000
Landy	6,000,000
La Villette ..	4,000,000
La Villette ..	2,000,000
St. Mandé ..	1,570,000
Paris-Plage ..	125,000
Pau	550,000
Pembroke	240,000
Perigueux	350,000
Perth, W.A. ..	125,000
Piggott & Co. ..	1,500,000
Plymouth	2,000,000
Poitiers	350,000
Pontypool	120,000
Port Elizabeth ..	400,000
Portsmouth	1,000,000
Portsmouth	2,000,000
Portsmouth	809,000
Portsmouth	2,000,000
Posen	450,000
Posen	700,000
Prague	140,000
Preston	1,400,000
Ramsgate	430,000
Reading	1,000,000
Reading	1,000,000
Reading	600,000
Redditch	500,000
Redhill	275,000
Redhill	300,000
Redhill	1,100,000
Reichenberg ..	200,000
Reichenberg ..	200,000
Reval	350,000
Rhymney	175,000
Rhymney	250,000
Riddings	258,000
Ripley	120,000
Rochester	2,200,000
Rochester	2,800,000
Romford	300,000
Romford	350,000
Rotterdam	850,000
Rotterdam	1,500,000
Rotterdam	750,000
Rotterdam	750,000
Rotterdam	600,000
Rotterdam	2,000,000
Royston (Yorks.) ..	250,000
Rugby	1,000,000
Rushden	425,000
Rushden	517,000
Saffron Walden ..	235,000
St. Albans	700,000
St. Andrews ..	210,000
St. Andrews ..	400,000
St. Gallen	225,000
St. Gallen	225,000
Ste. Ch. Gr. Paroisse	1,320,000
Sté. Pr. Ch. Kuhlmann	1,270,000
Sté. Tubes Meuse	545,000
San Paulo	700,000
Scarborough ..	800,000
Scarborough ..	200,000
Scarborough ..	350,000
Scarborough ..	1,300,000
Scarborough ..	1,350,000
Seaford	200,000
Shanghai	225,000
Shanghai	225,000
Shanghai	1,600,000
Shanklin	259,000
Sheerness	200,000
Sheerness	180,000
Sheerness	200,000
Sheffield	1,530,000
,, Steel Prods.	5,000,000
Shrewsbury ..	300,000
Sidmouth	225,000
Sittingbourne ..	259,000
Southampton ..	800,000
Southampton ..	500,000
Southampton ..	600,000
Southampton ..	100,000
Southampton ..	1,000,000
Southend	1,250,000
Southend	900,000
Southend	900,000
Southgate	400,000
Southgate	500,000
Southgate	800,000
Southgate	500,000
Southport	750,000
Southport	900,000
Southport	900,000
Southport	450,000
South Shields ..	650,000
South Shields ..	1,250,000
Stafford	500,000
Stettin	880,000
Stirling	400,000
Stockholm	1,500,000
Stockholm	1,750,000
Stockport	600,000
Stockport	600,000
Stockport	400,000
Stockport	400,000
Stockton	500,000
Stockton	250,000
Stourbridge ..	500,000
Stourbridge ..	500 000
Sunderland ..	2,250,000
Sunderland ..	300,000
Sutton	1,269,000
Swansea	750,000
Swansea	1,000,000
Swansea	450,000
Swansea	1,250,000
Swansea	2,000,000
Swindon	300,000
Swindon	450,000
Swindon	400,000
Sydney	1,000,000
Sydney	1,000,000
Sydney	1,000,000
Sydney	8,250,000
Taunton	225,000
Taunton	350,000
Tawe Valley ..	275,000
Teignmouth ..	200,000
The Hague	1,000,000
The Hague	500,000
The Hague	1,750,000
The Hague	1,500,000
The Hague	775,000
The Hague	1,500,000
Tilburg	400,000
Tirlemont	120,000
Tokyo	2,000,000
Torquay	350,000
Torquay	350,000
Torquay	320,000
Tottenham	750,000
Tottenham	750,000
Tottenham	350,000
Tottenham	1,000,000
Tottenham	1,000,000
Tottenham	1,250,000
Tottenham	2,500,000
Tottenham	1,000,000
Tottenham	500,000
Tottenham	1,000,000
Toulouse	1,800,000
Toulouse Natl. Wks.	2,400,000
Toulouse Natl. Wks.	6,200,000
Tournai	700,000
Tours	550,000
Trowbridge ..	250,000
Tunbridge Wells ..	1,000,000
Tunbridge Wells ..	1,000,000
Tunis	175,000
Tynemouth	1,100,000
Tynemouth	1,100,000
Ulm	400,000
Utrecht	1,000,000
Utrecht	1,000,000
Uxbridge	752,000
Vancouver	3,800,000
Verviers	1,000,000
Vienna	3,500,000
Vienna	2,500,000
Walsall	750,000
Walsall	375,000
Waltham	400,000
Waltham	140,000
Wandsbek	125,000
Wandsworth ..	1,800,000
Wandsworth ..	4,230,000
Wanganui, N.Z. ..	376,000
Ware	150,000
Ware	282,000
Warwick	125,000
Wasmuel	500,000
Watford	300,000
Watford	350,000
Watford	400,000
Wath	430,000
Weimar	100,000
Wellingborough ..	525,000
Wellingborough ..	525,000
Wellington, N.Z. ..	350,000
West Bromwich ..	550,000
Westgate	250,000
Weston-Mare ..	350,000
Weston-Mare ..	350,000
Weston-Mare ..	150,000
Weston-Mare ..	150,000
Wexford	100,000
Weymouth	400,000
Weymouth	100,000
Weymouth	658,000
Whitstable	423,000
Widnes	500,000
Wiesbaden	850,000
Winchester	225,000
Winchester	125,000
Winchester	410,000
Woking	400,000
Wolverhampton ..	1,500,000
Wolverhampton ..	1,000,000
Wolverhampton ..	250,000
Wolverhampton ..	400,000
Worthing	525,000
Yarmouth	500,000
Yarmouth	125,000
Yeovil	340,000
Zwolle	200,000
Zwolle	200,000
Zwolle	700,000

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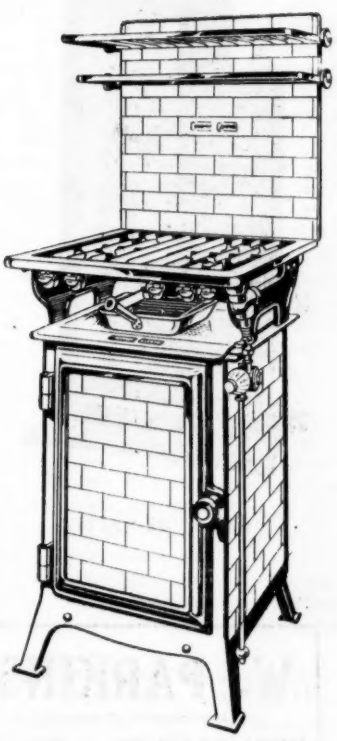

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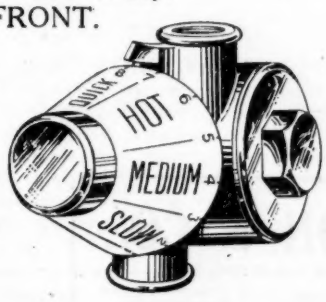

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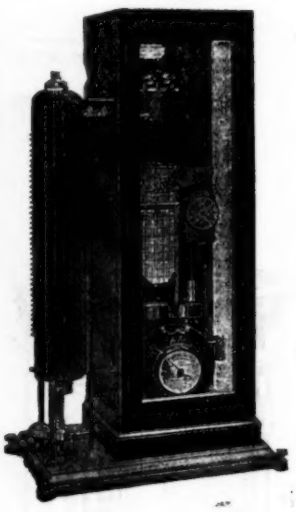

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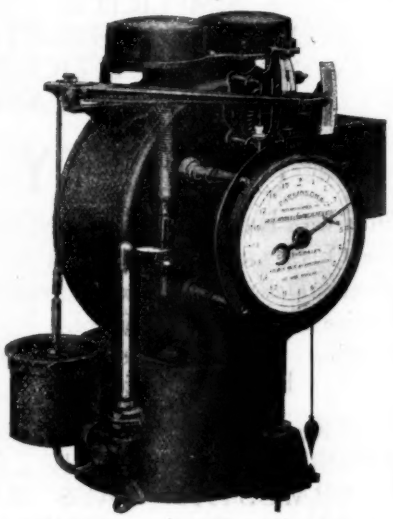

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